CARRIAGE, HANDLING AND STORAGE OF

DANGEROUS GOODS

ALONG THE MEKONG RIVER

VOLUME II: RECOMMENDATIONS

Mekong River Commission

Navigation Programme

MEKONG RIVER COMMISSION FOR SUSTAINABLE DEVELOPMENT

MRC

NAVIGATION PROGRAMME

DANGEROUS GOODS

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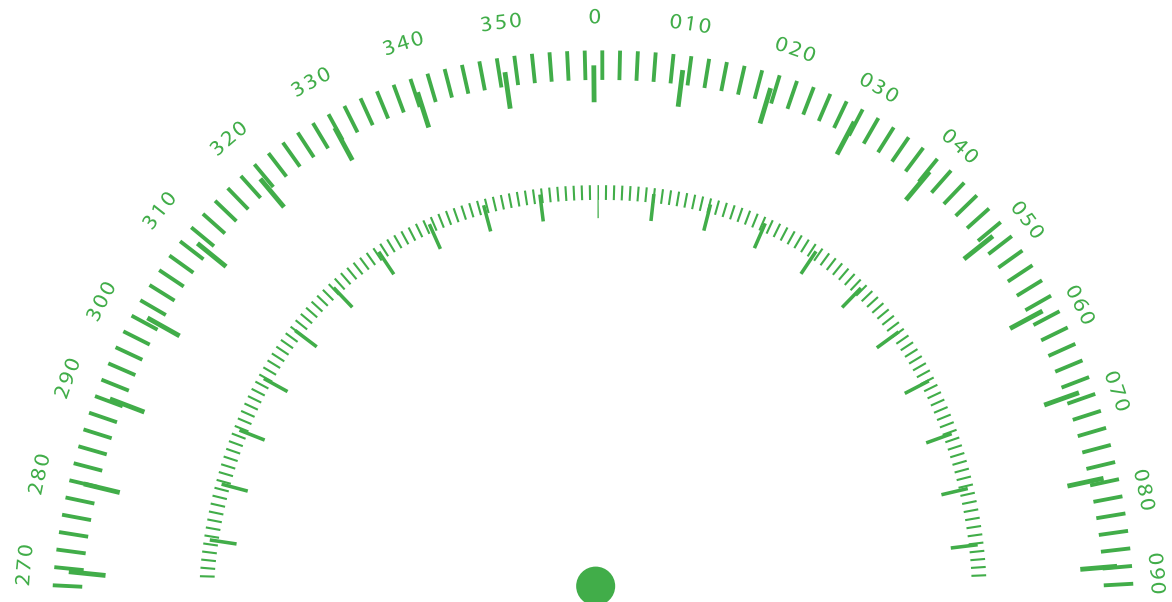

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PREFACE

To be provided

CONTENTS

ACRONYMS AND ABBREVIATIONS

ADN	Accord européen relatif au transport international des merchandises dangereuses par voie de navigation intérieure (European Agreement concerning the international carriage of dangerous goods by inland waterways)
ADNR	Accord Européen relatif au Transport International des Marchandises Dangereuses par voie de Navigation du Rhin (European Agreement concerning the international carriage of dangerous goods on the Rhine)
ADR	Accord européen relatif au transport international des marchandises Dangereuses par Route (European Agreement concerning the international carriage of dangerous goods by Road)
AFS	Anti-Fouling Systems on ships
AGN	European Agreement on Main Inland Waterways of International Importance
AIS	Automatic Identification System
ALARP	As low as reasonably practicable
ANSI	American National Standards Institute
API	American Petroleum Institute
AS/NZS	Australian Standard/New Zealand Standard
ASEAN	Association of SouthEast Asian Nations
ASME	American Society for Mechanical Engineeers
ASTM	American Society for Testing and Materials
BK2	Bulk Containers
C	Severity of possible consequences
CCNR	Central Commission for the Navigation of the Rhine
CCTV	Closed Circuit Television
CEO	Chief Executive Officer
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMI	Cambodian Maritime Institute
CNI	Cambodia Naval Institute
CNMC	Cambodia National Mekong Committee
CTU	Cargo Transport Unit (container)
CWG	Country Working Group National Counterpart to the NWG at the Mekong River

	Commission Secretariat
DIN	German Institute for Standardisation
DOT	Department of Transport
DNV	Det Norske Veritas
DG	Dangerous Goods
DGPS	Differential Global Positioning Systems
DO	Diesel Oil
DWT	Deadweight Tonnage
EA	Executive Agency
EBIS	European Barge Inspection Scheme
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EN	European Norm
EP	Environment Programme (of MRC)
EPC	Environmental Protection Commitment
ESIA	Environmental Social Impact Assessment
EUR	Euro (official currency of the eurozone)
F	Frequency
FASRB	Framework Agreement on the Sava River Basin
FO	Fuel Oil
FRTs	Floating Roof Tanks
FSO	Facility Security Officer
FSP	Facility Security Plan
GIS	Geographic Information System
GL	Germanischer Lloyd
GMS	Greater Mekong Subregion
GRT	Gross Register Tonnage
GPS	Global Positioning System
HFO	Heavy Fuel Oil
HNS	Hazardous and Noxious Substances
HSE	Health, Safety and Environment
IBCs	Intermediate Bulk Containers
ICPDR	International Commission for the Protection of the Danube Ribvrt
ID	Identification
IEC	International Electrotechnical Commission

ILO	International Labor Organisation
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organisation
INE	Inland Navigation Europe
ISGINTT	International Safety Guide for Inland Navigation Tank-barges and Terminals
ISO	International Organization for Standardisation
ISPS	International Ship and Port Facility Security
ISRBC	International Sava River Basin Commission
ISTEA	Industrial Safety Techniques and Environment Agency
IUCN	International Union for Conservation of Nature
IWD	Industrial Works Department
IWT	Inland Waterway Transport
Km	Kilometre
KO	Kerosene Oil
LAD	Least Available Depth
LCB	Leam Chabang Port
LMB	Lower Mekong Basin
LMRB	Lower Mekong River Basin
LNMC	Lao National Mekong Committee
LOA	Length Over All
LR	Lloyds Register
LPG	Liquid Petroleum Gas
MAWP	Maximum Allowable Working Pressure
MARPOL	Marine Pollution
MDO	Marine Diesel Oil
MEGCs	Multiple-Element Gas Containers
MFO	Marine Fuel Oil
MMPS	Ministry of Military and Public Security
MNFC	Mekong Navigation Facilitation Committee
MSC	Maritime Safety Committee (IMO)
MOGAS	Motor Gasoline
MOIT	Ministry of Industry and Trade
MOSTE	Ministry of Science, Technology and Environment
MOT	Ministry of Transport
MoWRAM	Ministry of Water Resources and Meteorology
MPWT	Ministry of Public Work and Transport

MRC	Mekong River Commission
MRCS	Mekong River Commission Secretariat
MRCS NPO	Mekong River Commission Secretariat Navigation Programme Office
MSDS	Material Safety Data Sheets
MTSA	Maritime Transportation Security Act
M/V	Motor Vessel
NACE	National Society of Corrosion Engineers (US)
NAP	Navigation Programme
NEG	Navigation Expert Groups
NFPA	National Fire Protection Association (US)
NNC	National Navigation Coordinator
NMC	National Mekong Committee
NOHSC	National Occupational Health and Safety Commission (Australia)
NWG	Navigation Working Group
OCIMF	Oil Companies International Marine Forum
ODA	Official Development Assistance
OISD	Oil Industry Safety Directorate (India)
ONEP	Office of Natural Resources and Environmental Policy and Planning
OSH	Occupational Safety and Health
OPRC	Oil Spill Preparedness and Response Cooperation
PACPLAN	Pacific Island Regional Marine Spill Contingency Plan
PACPOL	Pacific Ocean Pollution Prevention Program
PAH	Polycyclic Aromatic Hydrocarbons
PAT	Port Authority of Thailand
PCD	Pollution Control Department
PDR	Peoples' Democratic Republic
PEMSEA	Partnership in Environmental Management for the Seas of East Asia
PERC	Powered Emergency Release Coupling
PHSEMS	Port Health, Safety and Environmental Management System
PIANC	Permanent International Commission for Navigation Congresses. The International Navigation Association
POP	Persistent Organic Pollutants
PPAP	Phnom Penh Autonomous Port (Cambodia)
PPC	Provincial Peoples Committees
PPE	Personal Protective Equipment
PRC	Peoples Republic of China

PRF	Port Reception Facilities
PRP	Police River Patrol
PRSP	Poverty Reduction Strategy Papers
PSA	Port Security Assessment
PSC	Port State Control
PSHEMS	Port Safety and Health and Environmental Management System
PSN	Proper Shipping Name
QCDPS	Vietnamese Local Technical Regulation
QCVNs	Vietnamese national technical regulation
R	Risk Rating
RADAR	Radio Detection and Ranging
RGC	Royal Government of Cambodia
RA	Risk Analysis
RID	Règlement concernant le transport international ferroviaire des marchandises dangereuses (International rule for transport of dangerous substances by railway)
RWP	Rated Working Pressure
SEA	Strategic Environmental Assessment
SIA	Social Impact Assessment
SMS	Safety Management System
SOLAS	Safety of Life at Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SWL	Safe Working Load
SWP	Safe Working Procedures
TEU	Twenty-Foot Equivalent Units (intermodal shipping container)
TCCSs	Organization's Standards
TCVNs	Vietnamese National Standard
TG	Technical guidance
TMD	Thailand Marine Department
TNMC	Thailand National Mekong Committee
TWG	Technical Working Groups
UHA	Updating off the Hydrographic Atlas
UNCCD	United Nations Convention to Combat Desertification
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
USCG	United States Coast Guard
USD	US dollar

VEA	Vietnam Environment Administration
VHF	Very High Frequency
VINASARCOM	Vietnam's National Search and Rescue Committee
VIWA	Viet Nam Inland Waterway Administration
VND	Vietnamese dong
VNMC	Viet Nam National Mekong Committee
VR	Viet Nam Register
VSQI	Viet Nam Standards and Quality Institute
VTS	Vessel Traffic System
WG	National Working Group
WREA	Water Resources and Environment Authority
WQ	Water Quality
WQI	Water Quality Index
WQM	Water Quality Monitoring
WQMN	Water Quality Monitoring Network

DEFINITIONS

Administration: means the government of the state whose flag the ship is entitled to fly.

Approved equipment: equipment has been tested and approved by an appropriate authority; national line agency or classification society. The authority should have certified the equipment as safe for use in a specified hazardous or dangerous area.

Auto-ignition: the ignition of a combustible material without initiation by a spark or flame, when the material has been raised to a temperature at which self-sustaining combustion occurs.

Barge: any vessel or ship used for inland navigation.

Berth: any dock, pier, jetty, quay, wharf, marine terminal or similar structure (whether floating or not) at which a ship may tie up. It includes any plant or premises, other than a ship, used for purposes ancillary or incidental to the loading or unloading of dangerous cargoes.

Bulk: cargoes which are intended to be carried without any intermediate form of containment in a cargo space which is a structural part of a ship or in a tank permanently fixed in or on a ship.

Cargo area: the part of the ship which contains the cargo containment system, cargo pumps and compressor rooms, and includes the deck area above the cargo containment system. Where fitted, cofferdams, ballast tanks and void spaces at the after end of the aftermost hold space or the forward end of the forward most hold space are excluded from the cargo area.

Company: the owner of a ship or any other organisation or person, such as the manager or the bareboat charterer, who has assumed the responsibility for the operation of the ship from the owner of the ship.

Dangerous area: an area on a tanker which, for the purposes of the installation and use of electrical equipment, is regarded as dangerous.

Dangerous cargoes: any of the following cargoes, whether packaged, carried in bulk packaging or in bulk within the scope of the following instruments:

- Oils covered by Annex I of MARPOL 73/78;
- Gases covered by the Codes for the Construction and Equipment of Ships Carrying
- Liquefied gases in bulk;
- Noxious liquid substances/chemicals, including wastes, covered by the Codes for the
- Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk and Annex II of MARPOL 73/78;
- Solid bulk materials possessing chemical hazards and solid bulk materials hazardous only in bulk (MHBs), including wastes, cove red by group B schedules in the Code of Safe Practice for Solid Bulk Cargoes (BC Code);
- Harmful substances in packaged form (covered by Annex III of MARPOL 73/78); and
- Dangerous goods, whether substances, materials or articles (covered by the IMDG Code).

The term dangerous cargoes includes any empty uncleaned packagings (such as tank-containers, receptacles, intermediate bulk containers (IBCs), bulk packagings, portable tanks or tank vehicles) which previously contained dangerous cargoes, unless the packaging have been sufficiently cleaned of

residue of the dangerous cargoes and purged of vapours so as to nullify any hazard or has been filled with a substance not classified as being dangerous

Dangerous goods: means those substances and articles the carriage of which is prohibited by applicable legislation, or authorized only under the conditions prescribed therein.

Earthing (also referred to as "grounding"): the electrical connection of equipment to the main body of the 'earth' to ensure that it is at earth potential. On board ship, the connection is made to the main metallic structure of the ship, which is at earth potential because of the conductivity of the sea.

Enclosed space: a space that has limited openings for entry and exit, unfavourable natural ventilation, and that is not designed for continuous worker occupancy. This includes cargo spaces, double bottoms, fuel tanks, ballast tanks, pump rooms, cofferdams, void spaces, duct keels, inter-barrier spaces, engine crankcases and sewage tanks.

Explosion-proof (also referred to as "flame-proof"): Electrical equipment is defined and certified as explosion-proof when it is enclosed in a case that is capable of withstanding the explosion within it of a hydrocarbon gas/air mixture or other specified flammable gas mixture. It must also prevent the ignition of such a mixture outside the case either by spark or flame from the internal explosion or as a result of the temperature rise of the case following the internal explosion. The equipment must operate at such an external temperature that a surrounding flammable atmosphere will not be ignited.

Flame arrester: A permeable matrix of metal, ceramic or other heat-resisting materials which can cool even an intense flame, and any following combustion products, below the temperature required for the ignition of the flammable gas on the other side of the arrester.

Flammable: capable of being ignited and of burning.

Foam: an aerated solution that is used for fire prevention and fire-fighting.

Handling: the operation of loading or unloading of a ship, railway wagon, vehicle, freight container or other means of transport, transfer to, from or within a warehouse or terminal area or within a ship or transhipment between ships or other modes of transport and includes intermediate keeping, i.e. the temporary storage of dangerous cargoes in the port area during their transport from the point of origin to their destination for the purpose of changing the modes or means of transport and movement within the port which is part of the transport supply chain for those cargoes.

Hazardous area: an area on shore which, for the purposes of the installation and use of electrical equipment, is regarded as dangerous. Such hazardous areas are graded into hazardous zones depending upon the probability of the presence of a flammable gas mixture. (For ships, see "Dangerous area")

Hazardous task: a task other than Hot Work which presents a hazard to the ship, terminal or personnel, the performance of which needs to be controlled by a risk assessment process such as a 'Permit to Work' system or a controlled procedure.

Hot work: work involving sources of ignition or temperatures sufficiently high to cause the ignition of a flammable gas mixture. This includes any work requiring the use of welding, burning or soldering equipment, blow torches, some power driven tools, portable electrical equipment which is not intrinsically safe or contained within an approved explosion-proof housing, and internal combustion engines.

International Safety Management (ISM) Code: international standard for the safe management and operation of ships and for pollution prevention. The Code establishes safety management objectives and requires a Safety Management System (SMS) to be established by the Company and audited and approved by the flag administration.

Intrinsically safe: an electrical circuit, or part of a circuit, is intrinsically safe if any spark or thermal effect produced normally (i.e. by breaking or closing the circuit) or accidentally (e.g. by short circuit or

earth fault) is incapable, under prescribed test conditions, of igniting a prescribed gas mixture.

Loading arm: an articulated hard pipe system and its associated equipment, which may include; quick release couplings, emergency release systems or hydraulic power pack, used for the purpose of transferring dangerous cargoes.

Loading rate: the volumetric measure of liquid loaded within a given period, usually expressed as cubic metres per hour (m3/h) or barrels per hour (bbl/h).

Master (also referred to as "captain"): the person having command of a ship.

Material Safety Data Sheet (MSDS): a document identifying a substance and all its constituents. It provides the recipient with all necessary information to manage the substance safely.

Naked lights: open flames or fires, lighted cigarettes, cigars, pipes or similar smoking materials, any other unconfined sources of ignition, electrical and other equipment liable to cause sparking while in use, unprotected light bulbs or any surface with a temperature that is equal to or higher than the auto-ignition temperature of the products handled in the operation.

Non-volatile petroleum: petroleum having a flashpoint of 60ºC or above.

Oxygen meter: an instrument for determining the percentage of oxygen in a sample of the atmosphere drawn from a tank, pipe or compartment.

Packing: the packing, loading or filling of dangerous cargoes into receptacles, intermediate bulk containers (IBCs), freight containers, tank containers, portable tanks, railway wagons, bulk containers, vehicles, ship borne barges or other cargo transport units.

Packaged cargo: petroleum or other cargo stored in drums, packages or other containers.

Permit (to work): a document issued by a Responsible Person which allows work to be performed in compliance with the ship's Safety Management System (SMS)

Permit to work system: a system for controlling activities that expos e the ship, the terminal, personnel or the environment to hazard. The system will provide risk assessment techniques and apply them to the varying levels of risk that may be experienced. The system should conform to a recognised industry guideline.

Petroleum: crude oil and liquid hydrocarbon products derived from it.

Port authority: any person or body of persons empowered to exercise effective control in a port area.

Pressure surge: a sudden increase in the pressure of the liquid in a pipeline brought about by an abrupt change in flow rate.

Pressure/vacuum relief valve: a device that provides for the flow of the small volumes of vapour, air or inert gas mixtures caused by thermal variations in a cargo tank.

Safety Management System (SMS): a formal, documented system required by the ISM Code, compliance with which should ensure that all operations and activities on board a ship are carried out in a safe manner.

Slops: a mixture of cargo residues and washing water, rust or sludge which is either suitable or not suitable for pumping.

Spontaneous combustion: the ignition of material brought about by a heat producing (exothermic) chemical reaction within the material itself without exposure to an external source of ignition.

Static electricity: the electricity produced by movement between dissimilar materials through physical contact and separation.

Stowage: the positioning of packages, intermediate bulk containers (IBCs), freight containers, tank

containers, portable tanks, bulk containers, vehicles, ship borne barges, other cargo transport units and bulk cargoes on board ships, in warehouses, sheds or other areas.

Surge Pressure: a phenomenon generated in a pipeline system when there is a change in the rate of flow of liquid in the line. Surge pressures can be dangerously high if the change of flow rate is too rapid and the resultant shock waves can damage pumping equipment and cause rupture of pipelines and associated equipment.

Tank cleaning: the process of removing hydrocarbon vapours, liquid or residue from tanks. Tank cleaning is usually carried out so that tanks can be entered for inspection or hot work or to avoid contamination between grades.

Tanker: a ship designed to carry liquid petroleum, chemical or gas cargo in bulk.

Terminal: a place where tankers are berthed or moored for the purpose of loading or discharging petroleum cargo.

Torch (also referred to as "flashlight"): a battery operated hand lamp. An approved torch is one that is approved by a competent authority for use in a flammable atmosphere.

Toxicity: the degree to which a substance or mixture of substances can harm humans or animals. 'Acute toxicity' involves harmful effects to an organism through a single short term exposure. 'Chronic toxicity' is the ability of a substance or mixture of substances to cause harmful effects over an extended period, usually upon repeated or continuous exposure, sometimes lasting for the entire life of the exposed organism.

Ullage: the space above the liquid in a tank, conventionally measured as the distance from them calibration point to the liquid surface.

Volatile petroleum: petroleum having a flashpoint below 60ºC as determined by the closed cup method of test.

Water spray: a spray of water divided into coarse drops by delivery through a special nozzle for use in firefighting.

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EXECUTIVE SUMMARY
RECOMMENDATIONS (VOLUME II)

Inland navigation can contribute to making transport more sustainable, particularly when it substitutes for road transport. But inland shipping can also have considerable environmental impacts. Concerns in the Mekong River include water pollution from shipping accidents, disposal of waste and wastewater from vessels as well as the overall operations of vessels, ports, ferry crossings, refuelling stations and petroleum terminals along with the carriage, handling and storage of dangerous goods.

I**n December 2010, the Mekong River Commission (MRC) Navigation Programme (NAP) began the Phase 1 project, Risk Analysis of the Carriage, Handling and Storage of Dangerous Goods.** The project is part of the MRC Navigation Strategy and Programme Component 3 (Traffic Safety and Environmental Sustainability) which aims to improve safety, environmental protection and pollution control.

The Risk Analysis, which forms Volume I of this publication, provided a detailed analysis of the current situation of the transport of dangerous goods in Cambodia, Lao PDR, Thailand and Viet Nam. For each of the MRC Member Countries, it detailed priority areas for improvement in relation to ports/terminals, vessels, waterways, legal frameworks and the environment. The Risk Analysis was a significant body of work with National Working Groups collecting data and international experts building capacity through training in risk management and the risks associated with the transport of dangerous goods.

Major findings of the Risk Analysis include that inland waterborne transport and the transport of dangerous goods are most developed in Cambodia and Viet Nam, the Lower Mekong countries in terms of navigation. In the Mekong Delta in Viet Nam ,a number of petroleum terminals, refuelling stations and tankers are operating. In the Upper Mekong, exports of petroleum products from Thailand to the People's Republic of China and Myanmar are increasing. Ferry crossings are also used to carry dangerous goods between Thailand and Lao PDR with basic refuelling facilities located along the Mekong River .

The Risk Analysis also found that a number of ports and petroleum terminals in the MRC Member Countries do not have effective emergency response planning for fire, explosion and pollution incidents. At the same time, the existing legal framework needs to be reviewed and strengthened for the carriage of dangerous goods. Maintenance and management are limited at some ports, terminals and vessels. Public information and awareness related to dangerous goods, environmental protection and waste management need to be enhanced in all Member Countries.

This document, Volume II, determines strategic recommendations for improving the transport of dangerous goods in relation to the five components of the Risk Analysis. The recommendations contained in this volume are considered very high and high priority areas in all Member Countries.

The recommendations for ports and terminals (Chapter 2) and vessels (Chapter 3) are for the management and operations of ports, terminals and vessels in the Member Countries and the national line agencies responsible for compliance and enforcement. These recommendations provide guidance on technical/management and training/institutional capacity to address the very high and high priority areas determined in Volume I. The chapters also provide important strategic recommendations for improving the transport of dangerous goods at the regional and national level to ensure further monitoring and compliance of ports, terminals and vessel operations.

Strategic recommendations for waterways (Chapter 4), the legal framework (Chapter 5) and the environment (Chapter 6) cover institutional capacity, monitoring and compliance, emergency response and enhancing coordination between relevant line agencies, the private sector and other key stakeholders. This volume also summarises problems identified in the Risk Analysis and recommendations to improve the transport and management of dangerous goods at the national and regional levels to prevent pollution incidents and enhance coordination and monitoring of the navigation sector. Some of the recommendations can be implemented in the short term with limited investment. Others, however, will require more investment, capacity building and further consultation with Member Countries to develop a strategic plan. In this regard, the recommendations in this volume will be used to develop the Phase 2 project, the Implementation Strategy and Development Programme for Sustainable Management of Dangerous Goods. Member Countries, line agencies, the private sector, donor agencies and the investment banks are encouraged to study these recommendations and consider how they can be implemented and consider the potential opportunities and difficulties.

Volumes I and II provide a useful framework to ensure a balance between inland waterborne transport and environmental protection. The Risk Analysis will be an important reference for the MRC, national line agencies, development partners and the private sector for many years to come. The Navigation Programme looks forward to the opportunity of working together with the Member Countries and navigation sector to improve the transport of dangerous goods in the Lower Mekong Basin (LMB) to:

- prevent pollution and environmental damage to the water resources of the Mekong River;
- protect the lives of workers, crewmembers and riparian communities; and
- enhance emergency response and effective coordination for oil spills, fires and other major accidents along the waterway.

1. FROM RISK ANALYSIS TO RECOMMENDATIONS

1.1 OVERVIEW:

Inland navigation can contribute to making transport more sustainable, particularly when it substitutes for road transport. But inland shipping can also have considerable environmental impacts. Concerns in the Mekong River include water pollution from shipping accidents, disposal of waste and wastewater from vessels as well as the overall operations of vessels, ports, ferry crossings, refuelling stations and petroleum terminals along with the carriage, handling and storage of dangerous goods.

I**n December 2010, the Mekong River Commission (MRC) Navigation Programme (NAP) began the Phase 1 project, Risk Analysis of the Carriage, Handling and Storage of Dangerous Goods.** The project is part of the MRC Navigation Strategy and Programme Component 3 (Traffic Safety and Environmental Sustainability) which aims to improve safety, environmental protection and pollution control.

The NAP development objectives are to promote freedom of navigation and increase international trade opportunities for the mutual benefit of MRC Member Countries and to help develop effective and safe waterborne transport in a sustainable and protective manner for the waterway environment. The specific objectives of the Risk Analysis were to identify and determine the magnitude of risks associated with the carriage, handling and storage of dangerous cargoes in ports, vessels and oil and gas terminals on the Mekong River, and determine feasible prevention and mitigation measures to manage the risks.

Petroleum products and other dangerous goods are increasingly being transported along the Mekong River. If not managed properly, these cargoes have the potential to cause significant pollution and even cause major incidents such as fires and explosions impacting on riparian communities. The Risk Analysis included assessing the operational impacts of ports, terminals and vessels and also the waterway, environment and the legal framework which governs international, cross-border and domestic transport.

Trans-boundary aspects of pollution need to be considered. The development of inland waterborne transport (IWT) in the Mekong River Basin will inevitably increase the risks of pollution from ports and vessel operations, oil spills and increased solid and liquid wastes. Pollution could become a trans-boundary issue since the Mekong is an international river with stretches where the international border follows the river alignment and stretches where the river crosses international borders. It is therefore essential for the countries to develop, adopt and enforce effective trans-boundary measures to prevent pollution and mitigate the impacts of accidents, oil spills and pollution incidents.

1.2 IMPLEMENTATION

The Risk Analysis, which forms Volume I of this publication, provided a detailed analysis of the current situation of the transport of dangerous goods in Cambodia, Lao PDR, Thailand and Viet Nam. For each of the MRC Member Countries, it detailed priority areas for improvement in relation to ports/terminals, vessels, waterways, legal frameworks and the environment. The Risk Analysis was a significant body of work with National Working Groups collecting data and international experts building capacity through training in risk management and the risks associated with the transport of dangerous goods.

The National Working Groups collected data, assessed risks and were responsible for implementing and overseeing the national components of the project. They were supported by the Navigation Programme and international experts engaged by the MRC to provide technical expertise to ensure the successful completion of specific outputs and activities of the risk analysis. An international expert was also engaged to complete an assessment of the legal frameworks governing the transport of dangerous goods in Member Countries. At the same time, waterways were assessed to determine the suitability of specific sections of the Mekong River for transporting dangerous goods.

After the National Working Groups completed data collection and questionnaires in January 2011, the MRC conducted a regional risk assessment workshop in Vientiane on 14 and 15 February. The workshop provided the National Working Groups and line agencies the objectives and scope of the Risk Analysis and training was provided on the risk assessment methodology developed for the project. The methodology used for the risk analysis is illustrated in Figure 1.

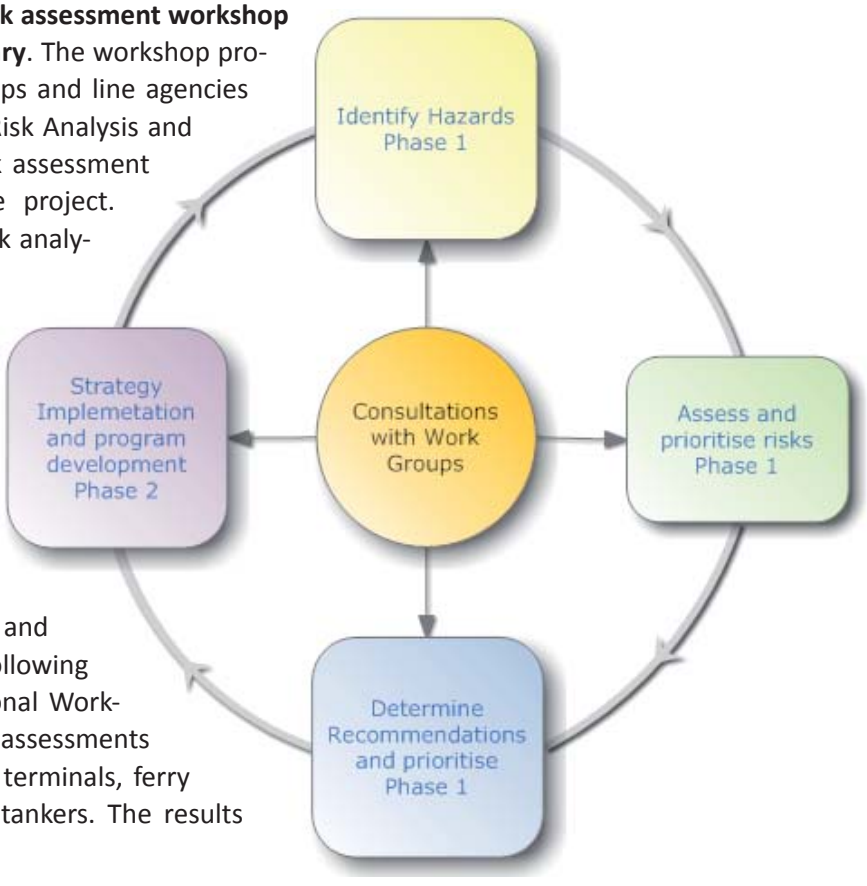

Figure 1: **Risk Analysis Process**

Data collection, site visits and the regional risk assessment workshop were important opportunities to identify the hazards associated the transport of dangerous goods. The Navigation Programme developed standard risk registers to assess selected ports, terminals and vessels in Member Countries. Following the regional workshop, the National Working Groups completed the risk assessments at the selected ports, petroleum terminals, ferry crossings and cargo vessels and tankers. The results

were reviewed in the Member Countries in June and July 2012 to determine priority areas for improving transport of dangerous goods. The level of the existing standards applied in each of the Member Countries was determined using the criteria illustrated below in Figure 2.

Figure 2: **Criteria Used to Assess and Prioritise Risks**

To determine priority areas, the Navigation Programme and the international consultants analysed the risk assessments, data and information to determine the risk levels in Member Countries. Existing standards from the Member Countries were then compared with the following risk criteria:

- international benchmarks;
- causes of major incidents in the maritime, inland waterborne transport (IWT) and petroleum sector; and
- possible severity of impacts from fires, explosions and pollution.

National consultations were held with national line agencies and key stakeholders in the transport of dangerous goods in November and December 2011. The aim was to review the findings from the risk analysis and determining priority areas for implementation at the national and regional level. Inputs from the consultations were used to finalise the Risk Analysis in Volume I and to prepare these Recommendations in Volume II.

A final regional workshop was held in Bangkok on 12 and 13 January in Bangkok. The workshop provided an opportunity to review the findings of Risk Analysis at the regional level. Participants were also required to prioritise the draft recommendations for ports/terminals, vessels, waterways, legal frameworks and the environment. National and regional priorities are included.

Volumes I and II provide a useful framework to ensure a balance between inland waterborne transport and environmental protection. The Risk Analysis will be an important reference for the MRC, national line agencies, development partners and the private sector for many years to come. The Navigation Programme looks forward to the opportunity of working together with the Member Countries and navigation sector to improve the transport of dangerous goods in the Lower Mekong Basin (LMB) to:

- prevent pollution and environmental damage to the water resources of the Mekong River;
- protect the lives of workers, crewmembers and riparian communities; and
- enhance emergency response and effective coordination for oil spills, fires and other major accidents along the waterway.

1.3 OUTCOMES

Inland waterborne transport and the transport of dangerous goods are most developed in Cambodia and Viet Nam. In Cambodia, there are 12 major petroleum terminals on the Mekong River system that are used to import gasoline, diesel, jet fuel and LPG in cross-border barges from Viet Nam (Figure 3). Cambodia imports around 80 percent of its petroleum and petroleum products from Viet Nam. Floating fuel terminals on the Tonle Sap Lake are used for refuelling. Domestic transport of dangerous goods is generally limited (Figure 4).

Figure 3: **Petroleum Terminal on the Mekong River, Cambodia**

Figure 4: **Floating Fuel Terminal Operating on the Tonle Sap Lake, Cambodia**

In Viet Nam, there are a numbers of petroleum terminals, refuelling stations and tankers operating in the Mekong Delta (Figure 5). The domestic transport of dangerous goods is extensive in the delta, with a number of large and small tankers used to supply petroleum terminals and the industrial sector along the the Bassac River (Song Hau) and the Mekong River (Song Tien).

Figure 5: **Viet Nam Domestic Tanker Loading Cargo on the Bassac River (Song Hau), Viet Nam**

In the Upper Mekong, exports of petroleum products from Thailand to the People's Republic of China and Myanmar are increasing. Keawalee Terminal in Chiang Saen is a privately-operated terminal used to discharge petroleum products to tanker barges from the People's Republic of China and Myanmar. Diesel and gasoline exports from Chiang Saen to these two countries reached 17 million litres in 2011 and are projected to climb to 100 million litres a year after Chiang Saen Port II starts operating in 2012.

Figure 6: **Chinese Tanker Barge Loading Cargo at Keawalee Terminal, Thailand.**

Ferry crossings are also used to carry dangerous goods between Thailand and Lao PDR with basic refuelling facilities located along the Mekong River (Figure 7). Within Lao PDR, there is limited storage and transport of dangerous goods, although Km 4 State Port has underground fuel tanks. The expansion of the Lao mining industry will require close monitoring to ensure dangerous goods are not carried on the Mekong River in the future.

Figure 7: **Ferry Crossing Between Chiang Khong, Thailand, and Huay Xay, Lao PDR**

1.3.1 Emergency Response, Oil Spills and Wastes

A number of ports and petroleum terminals in the Lower Mekong Basin do not have effective emergency response planning for fire, explosion and pollution incidents. Emergency response plans should involve consultations with local communities and authorities, especially where terminals are located in densely-populated areas. Navigation and communication equipment is not adequate for vessels carrying dangerous goods and there are no emergency response mechanisms available along the waterway to respond to accidents and oil spills. Further coordination is required at the regional and national levels for emergency response planning including early warning systems and incident notifications. There are also security and safety concerns for involved in the international carriage of dangerous goods, passengers and other cargoes. Waste management facilities are also limited along the Mekong River for solid and liquid (bilge and heavy oils) wastes. As navigation increases so does the amount of wastes, increasing risks to the environment and public health.

1.3.2 Legal Framework

The existing legal framework needs to be reviewed and strengthened for the carriage of dangerous goods. Viet Nam has the most extensive legal instruments for IWT. A review needs to be undertaken to determine the effectiveness of the existing rules, decrees and circulars specific to the transport of dangerous goods. Cambodia and Lao PDR are currently drafting rules and regulations and need to consider existing regional and international standards and levels of socio-economic development. Developing harmonised rules and regulations for the transport of dangerous goods along the Mekong River has been identified as a high priority for all Member Countries. Further coordination is required at the regional level to monitor the transport of dangerous goods. To ensure petroleum terminals, ports and vessels comply with environmental legislation, cooperation between national line agencies responsible for inland waterborne transport, environmental protection and water resources needs to be enhanced.

1.3.3 Enforcement and Compliance

Maintenance and management were limited at some of the ports, terminals and vessels visited during the Risk Analysis. A number of terminals and ports were in poor structural condition with equipment poorly maintained and not calibrated properly, increasing the risks of pollution, fire, explosion and other incidents. This reflects not only the failure of private operators to invest in safety and environmental protection but also limited government monitoring of facilities and operations. National line agencies have limited budgets, resources and technical capacity to perform monitoring and compliance activities for navigation and petroleum terminals. In respect to the environment, water quality monitoring needs to be improved to determine oil spill pollution and impacts of navigation and other industries. Environmental management plans (EMP) should be developed by ports and terminals to ensure the risks of pollution are effectively controlled and monitored.

1.3.4 Public Information and Awareness

Public information and awareness related to dangerous goods, environmental protection and waste management need to be enhanced in all Member Countries. Limited awareness and understanding of the risks associated with dangerous goods increases the potential for pollution, fire, explosion and other incidents. Training and capacity building for all port workers, vessel operators and all waterway users on the safe handling of dangerous goods is required. Capacity building is also needed for national line agencies for monitoring and compliance related to dangerous goods at ports and terminals and onboard vessels. Public information campaigns should be available in riparian languages for all waterway users. To encourage private sector investment in safety, environmental protection and oil spill response, industry forums could be established in partnership with the MRC and the public sector.

1.4 RECOMMENDATIONS

Volume II determines strategic recommendations for improving the transport of dangerous goods in relation to the five components of the Risk Analysis. The recommendations contained in this volume are considered very high and high priority areas in all Member Countries.

The recommendations for ports and terminals (Chapter 2) and vessels (Chapter 3) are for the management and operations of ports, terminals and vessels in the Member Countries and the national line agencies responsible for compliance and enforcement. These recommendations provide guidance on technical/management and training/institutional capacity to address the very high and high priority areas determined in Volume I. The chapters also provide important strategic recommendations for improving the transport of dangerous goods at the regional and national level to ensure further monitoring and compliance of ports, terminals and vessel operations.

Strategic recommendations for waterways (Chapter 4), the legal framework (Chapter 5) and the environment (Chapter 6) cover institutional capacity, monitoring and compliance, emergency response and enhancing coordination between relevant line agencies, the private sector and other key stakeholders. This volume also summarises problems identified in the Risk Analysis and recommendations to improve the transport and management of dangerous goods at the national and regional levels to prevent pollution incidents and enhance coordination and monitoring of the navigation sector. Some of the recommendations can be implemented in the short term with limited investment. Others, however, will require more investment, capacity building and further consultation with Member Countries to develop a strategic plan. In this regard, the recommendations in this volume will be used to develop the Phase 2 project, the Implementation Strategy for Sustainable Management of Dangerous Goods. Member Countries, line agencies and the private sector are encouraged to study these recommendations and consider how they can be implemented and consider the potential opportunities and difficulties.

2. PORTS AND TERMINALS

2.1 INTRODUCTION

The natural resources, environment and quality of the water in the Mekong River are increasingly under stress caused by solid waste, sewage and industrial wastewater disposed of into the river with no or limited treatment. If not well managed, the storage and handling of dangerous goods in ports and terminals along the Mekong River will cause environmental damage and an inevitable loss of aquatic resources with profound economic repercussions. Controlling the risks associated with storing and handling dangerous goods will depend on joint efforts, exchange of information and cooperation between the riparian countries as the impact of most risks will go beyond national boundaries.

Facts and figures from the MRC Member Countries indicate growing demand for storing and handling dangerous goods. New ports handling and storing dangerous goods are being developed in Cambodia and Thailand. At the same time, navigation of waterways has improved and Cambodia's production of oil, scheduled to start at the end of 2012, will increase demand for storage capacity. Given its position as Southeast Asia's third-largest oil producer along with the cost-effectiveness and relative fuel efficiency of inland waterborne transport, Viet Nam is likely to see increased demand for storage capacity as well.

If not carefully managed, the carriage, handling and storage of dangerous goods pose risks that are potentially hazardous for people, property and the environment. Recent accidents in the oil industry and at ports indicate the need for continuous vigilance from all people involved. The Risk Analysis (Volume 1) considered the potential impact dangerous goods can have on people, property and the environment. Since all risks can never be eliminated, some will always have to be accepted. The main challenge is to determine the level of acceptance and to resolve the conflict between risk and economic benefits.

The eventual goals are to find a way to manage the carriage, handling and storage of dangerous goods so that benefits are optimal, eventual risks are reduced to an acceptable level and impacts are minimised by being well prepared and equipped in case of an accident or incident. The risk assessment should not be considered as a "one-time" exercise. As its ultimate aim is to identify appropriate control measures that will reduce the risk of dangerous goods to people, property and the environment to as low as reasonably practicable (ALARP), the assessment should be reviewed regularly.

This should certainly be the case if a port or terminal is involved in a dangerous goods incident/accident or if a review is demanded by circumstances such as major changes to storage or handling systems, the emergence of new technologies, changes in the state of knowledge about certain hazards or the availability of new control measures.

Based on data compiled and risk assessed by the National Working Groups (see Volume I) in addition to questionnaires and national consultations, priority areas have been assigned to the different ports and terminals each of the riparian countries. These are:

- Cambodia–Low Standard Terminal;
- Cambodia–Phnom Penh Port;
- Viet Nam–Standard Terminal;
- Thailand–Standard Inland Port; and
- Lao PDR–Standard Inland Port.

The priority areas are based on ports handling dangerous goods in packaged form and terminals handling dangerous goods in bulk. The *International Maritime Dangerous Goods (IMDG) Code* was used as a reference since most riparian countries are familiar with the Code.

2.2 PREPARATION OF RECOMMENDATIONS

Some of the recommendations that follow will not be applicable to all Member Countries as they are already covered by existing national regulations or standards. If such regulations or standards are stricter, they must be observed and these recommendations do not apply.

In Volume I, risk levels where categorized in a numbered format. The possible consequence of each hazard was given a rating and this was multiplied by frequency of occurrence:

Risk Level = Frequency of accidents/incidents x Severity of the Consequences

T**o reduce the risk level, it is necessary to:**

- **reduce the frequency of accidents/incidents from happening;**
- **reduce the possible severity of consequences when an accident/incident happens;**
- **reduce both the frequency and the severity of the possible consequences**

Recommendations for prevention are intended to remove the causes of incidents or reduce the likelihood/frequency of an incident occurring. The hazard remains but the frequency of incidents involving the hazard is lowered. Control measures taken *before* an accident/incident, emergency, loss or problem occurs. An examples of a prevention measures is isolating valves to enable safe maintenance work, operating procedures and instructions.

Recommendations for mitigation are intended to reduce the severity of the consequences of an incident, ensuring that there are measures in place to respond effectively to incidents i.e. contingency planning and emergency response. They may be considered as the "last line of defence" if the risk cannot be reduced to a negligible level by other means. Control measures taken *after* an accident/incident, emergency, loss or problem has occurred. Examples of mitigation measures include fire-suppression and fire-detection systems, emergency planning and procedures.

The example of hot work on the following page illustrates that both recommendations for prevention and mitigation are important. Even if all possible prevention measures are in place to carry out hot work, the possibility of an accident (fire, explosion, injury) occurring will always exist (for example, human error) and therefore mitigation measures are necessary.

Figure 8: **Examples of Prevention and Mitigation Measures**

Each recommendation contains four sections:

1. **Recommendation** refers to the specific recommendation regarding items or hazard groups included in the risk register (see Volume 1) .
2. **Challenge** provides the reader with a brief summary of results from the risk assessment, the questionnaires and the national consultations (see Volume 1) .
3. R**eferences** used to develop the recommendation from national, industry and international standards. The main references are:
    - *International Safety Guide for Inland Navigation Tank-Barges and Terminals* (ISGINTT, Edition 1, 2010). The main purpose of ISGINNT is to improve the safe transport of dangerous goods at the interface of inland tank barges with other vessels or shore facilities (terminals). ISGINTT can be downloaded free of charge from the following location: http://www.isgintt.org/300-nl.html.
    - *Revised Recommendations on the Safe Transport of Dangerous Cargoes and Related Activities in Port Areas.* The Maritime Safety Committee of the International Maritime Organisation (IMO) approved these revisions as *MSC.1/Circ.1216* at its 82nd session (29 November to 8 December 2006). They recognise the need to align the relevant provisions of the recommendations with those of the amended IMDG Code and the ISPS Code concerning security provisions. The revised recommendations can be downloaded free of charge form the following location: http://www.imo.org/blast/blastDataHelper.asp?data_id=18089&filename=1216.pdf
    - Other reference standards from the following organisations have been consulted:
        - ASME – American Society of Mechanical Engineers;
        - ANSI – American National Standards Institute;
        - API – American Petroleum Institute;
        - AS – Australian Standards;
        - ASTM – American Society for Testing and Materials;
        - DIN – German Institute for Standardisation;
        - EN – European Norm;
        - IEC – International Electrotechnical Commission;
        - ISO – International Organisation for Standardisation;
        - NACE – National Association of Corrosion Engineers (US);
        - NFPA – National Fire Protection Association (US);
        - NOHSC – National Occupational Health and Safety Commission (Australia);
        - OISD – Oil Industry Safety Directorate (India);
        - PEMSEA – Partnerships in the Environmental Management for the Seas of East Asia; and
        - USCG – United Sates Coast Guard.
4. **Actions** relating to technical and management issues and those pertaining to institutional and capacity-building issues.

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2.3 RECOMMENDATIONS FOR PREVENTION

The recommendations for prevention have been divided into the following sections for ports and terminals:

1. **Location and Security**
   - Location of Ports and Terminals; and
   - Access to Port and Terminal Facilities.
2. **Infrastructure and Critical Equipment**
   - Storage Tank Structure;
   - Storage Tank Secondary Containment (Bunding);
   - Cargo Transfer Equipment;
   - Level Gauges, Capacity Alarms and Overfill Prevention;
   - Fire and Gas Detection Equipment and System Alarms; and
   - Electrical Equipment.
3. **Operational Performance and Integrity**
   - Inspection and Testing of Critical Equipment; and
   - Maintenance of Critical Equipment.
4. **Health, Safety and Environmental (HSE) Management**
   - Port Health, Safety and Environmental Management System (PHSEMS);
   - Segregation and Storage of Dangerous Goods;
   - Monitoring and Control of Dangerous Goods;
   - Checklist for Critical Operations;
   - Waste Management; and
   - Drug and Alcohol Policy.

2.3.1 Location and Security

2.3.1.1 Location of Ports and Terminals

RECOMMENDATION
Member countries should consider the impacts of port and terminal operations on local communities in densely- populated areas.

Challenge

Some ports and terminals are located close to residential areas. In the event of a fire, explosion or any other emergency, they can put the local community at risk. In case of a major incident, one which cannot be dealt with by in-house emergency resources alone and requires external resources, there is no off-site emergency plan available. Such plans should be activated in the occurrence of a major incident or an uncontrolled event which could lead to a major incident.

Prevention measures do not guarantee that a major incident will not occur so it is necessary to have an emergency plan ready for use if circumstances require. Trucks loaded with dangerous goods going to and from premises have to pass through densely-populated areas. Hot work and open fire outside the terminal premises have not been found to create additional hazards. However, one terminal operator asked about the possibility of determining a waterfront safety perimeter prohibiting the mooring of vessels other than these calling at the terminal and construction activities from being carried out.

ACTIONS
Technical and Management

All emergency equipment should be well maintained, readily accessible and in good working order.

Terminal operators with the potential to cause a major incident should:

- ensure that they have fully competent and trained staff available 24/7 to execute on-site emergency plans and have an emergency control centre with a readily-available duplicate set of plans and technical information about the terminal; and
- communicate with the local community on how they will be informed in the event of a major accident/incident and what has to be done in case of such an emergency.

Institutional and Capacity Building

On and Off-site emergency planning

Relevant line agencies should identify and map terminals with the potential to cause an incident that extends beyond the boundaries of the premises and check the availability of materials, equipment and resources critical to respond successfully to a major emergency at both local and national levels.

Terminals with a potential to cause a major incident should prepare an emergency plan for dealing with the off-site consequences of a possible major incident. The plan should be prepared in close cooperation with all relevant line agencies as well as fire and rescue authorities.

Relevant line agencies and terminal operators should ensure that staff are trained and are competent to perform the necessary actions required during a major incident.

Institutional and Capacity Building (continued)

2.3.1.2 Access to Ports and Terminal facilities

RECOMMENDATION
Member countries should consider establishing an exclusion zone and a safety perimeter to prevent unauthorised access to ports and terminal facilities.

Challenge

Most terminals and ports included in the risk analysis have a surrounding wall or fence with gates permanently guarded and provided with CCTV. However, some do not have a security plan available or have a security officer. Some of the ports and terminals receiving seagoing vessels did not comply with the ISPS Code. Operating a port or terminal without ISPS certification where it is compulsory increases the risk of security-related incidents. In Europe, several governments have recognised the security of inland waterways and ports as a problem and have developed a special "Security Toolkit". Its basic framework is the same as the toolkit for port facilities servicing seagoing vessels.

ISPS Code

In 2002, the IMO adopted a major security-related amendment to the *Convention of Safety Of Live At*

Sea (SOLAS). The new Chapter XI-2 contains the *International Ship and Port facility Security (ISPS) Code*. The ISPS Code is designed to protect ports and international shipping against terrorism. The ship/port interface is seen as a potential point of weakness for security measures.

Part A of the ISPS Code is mandatory for all contracting countries whereas Part B contains recommended actions. The code provides for all vessels bigger than 500 Gross Registered Tonnage (GRT), mobile offshore drilling units, and port facilities serving ships which are engaged in international voyages.

Code of Practice on Security in Ports (ILO)

Chapter XI-2 of SOLAS is supplemented by the ISPS Code, which contains requirements that relate to the security of the ship and to the immediate ship/port interface. The overall security of port areas was left to further joint work between the ILO and the IMO. The code of practice provides a guidance framework for the development of a strategy appropriate to identifying threats to security in ports.

ISO 28000

The ISO 28000 series of International Standards specifies the requirements for a security management system to ensure security in the supply chain. Its standards can be applied internationally to all routes and transport modes, to combat smuggling, to meet threats of piracy and terrorism and to create a secure management approach to the international supply chain.

References

- *OCIMF, Guidance for Oil Terminal Operators on the International Maritime Organisation (IMO) International Ship and Port Facility Security (ISPS) Code*
- *IMO & ILO, Code of Practice on Security in Ports*
- *Transport Research Support Program, Supply Chain Security Guide (World Bank/DFID).*
- *MSC 86/INF.6 Measures to Enhance Maritime Security – ISO Maritime and Supply Chain Security Standards*

ACTIONS

Technical and Management

For ports/terminals where the ISPS Code is mandatory, necessary procedures should be developed to comply with the requirements.

Inland ports or terminals where the ISPS Code is not mandatory should, on a voluntary basis, comply with the ILO *Code of Practice for Security in Ports* or seek an ISO 28000 accreditation.

Port and terminal operators should carry out a port security assessment (PSA) and develop a facility security plan (FSP) based on the findings of the PSA. The FSP should contain the necessary measures and procedures to reduce the risk to ports from threats posed by unlawful acts.

Institutional and Capacity Building

Relevant line agencies should verify if ports and terminals have implemented sufficient measures and procedures to deal with security-related incidents and unlawful acts.

Port Facility Security Officers (FSO) should be trained and have the necessary skills as they will be the designated people responsible for the development, implementation, revision and maintenance of the FSP and for liaison with security officers of vessels and company security officers.

Drills and exercises should be conducted at appropriate intervals to ensure the adequacy of the FSP.

2.3.2 Infrastructure and Critical Equipment

2.3.2.1 Storage Tank Structure

RECOMMENDATION
Member countries should determine minimum standards for storage tank structures and monitoring programmes to ensure the integrity of such structures.

Challenge

Problems with tank structures were identified. At one site, several tanks were out of service due to maintenance issues. Considering the age of the terminals and related equipment, storage tank integrity needs to be well managed as the tanks contain large volumes of hazardous liquids and their failure has the potential to result in serious and dramatic events, causing harm to the environment, property and local communities.

There have been many accidents with storage tanks. Causes range from faulty welding or use of sub-standard steel to modifications and changes or faulty repairs and maintenance. Tanks are often perceived as simple structures that require little attention. Yet corrosion, erosion, fatigue and mechanical damage associated with them can be complex and varied, causing tanks to deteriorate and fail.

Postponing any examination, whether intermediate or thorough, needs careful consideration. The full operational parameters, inspection history and any potential or known degradation need to be taken into account. This recommendation has been included as tank cracks and rupture are one of the main causes of major tank incidents and they are critical equipment for each terminal.

References

- *API, Standard No. 620, Recommended Rules for Design and Construction of Large Welded Low-Pressure Storage Tanks, 9th Edition;*
- *API 610 Standard 2610, Design, Construction, Operation and Maintenance of Terminal and Tank Facilities (2005);*
- *API Standard 653, Tank Inspection, Repair, Alteration, and Reconstruction, 2nd Edition;*
- *Steel Structure Painting Council, Steel structure Painting, Manual, Volume I Good painting Practice, 3rd Edition;*
- *NFPA 30, Minimum Tank Spacing;*
- *API RP 575, Guidelines and Methods for Inspection of Existing Atmospheric and Low-Pressure Storage Tanks;*
- *EEMUA 159, Maintenance and inspection of above ground vertical steel cylindrical storage tanks; and*
- *HSG 176, The Storage of Flammable Liquids in Tanks.*

ACTIONS
Technical and Management

Oil storage tanks should be provided with a release-prevention barrier with a leak-detection system.

All storage tanks should be provided with a corrosion protection system for the part of the tank in contact with the soil unless a cathodic protection assessment indicates corrosion will not reduce the floor thickness below the minimum allowed before the next internal inspection.

Tanks must be painted in accordance with nationally-recognised industry standards.

According Section 6 of API Std 653, tanks should be inspected based on service history and from corrosion rates determined by previous inspections. Where not known, it recommends:

- external inspections every 5 years;
- internal inspections every 10 years; and
- inspection intervals never exceeding 20 years.

Procedures be in place for monthly visual inspections of storage tanks for discharges and maintenance deficiencies.

Tank inspections and repairs should only be carried out by a qualified and competent person. Documentation of inspections and tests should be kept at the terminal.

Institutional and Capacity Building

Relevant line agencies should determine minimum standards for the design, construction, maintenance and testing of storage tanks.

2.3.2.2 Storage Tank Secondary Containment (Bunding)

RECOMMENDATION
Member countries should ensure that petroleum terminals and ports have adequate secondary containment (bunding) for storage tanks in case of a major spill or overflow.

Challenge

The secondary containment (bunding) is very important to contain liquid in the event of a leak or an overflow. The National Working Groups did not have the necessary technical equipment at their disposal to determine whether such were sufficient. Without this equipment, it is difficult to determine the exact content of the secondary containment, to establish the condition of the bund wall and floor construction and to verify if the penetration joints are leak-tight. Some major accidents have proven the importance of secondary containment and therefore it is included in the recommendations.

Although priority should be given to preventing a loss of primary containment, adequate secondary containment remains necessary as this will provide assurance for protecting the environment and the safety of local communities in the event of a loss of primary containment.

ACTIONS
Technical and Management

All oil terminal facilities must have diked areas designed, constructed and maintained to prevent oil from entering the river or adjacent property.

Bund wall and floor construction and penetration joints should be leak-tight. Surfaces should be free from any cracks, discontinuities and joint failures.

The containment for all facilities must be verified when modifications to the diked areas or the capacity of the storage tanks are made and otherwise every 10 years. Dike walls that have eroded or degraded over time must be repaired.

All drainage through an oil/water treatment system from a containment dike must be locked out from discharge except at times of supervised drainage. All drainage must flow through an oil/water separator.

Procedures should be developed to check bund walls/floors visually and to perform repairs on the diked area.

Modifications and repairs should be documented and kept at the terminal.

Institutional and Capacity Building

Relevant line agencies should develop minimum requirements for the design and construction of secondary containment (bunding) systems.

2.3.2.3 Cargo Transfer Equipment

RECOMMENDATION
Member Countries should establish minimum standards for the safe installation, operation, inspection, testing and maintenance of cargo transfer equipment.

Challenge

Several hazards have been identified concerning cargo transfer equipment which includes loading arms, cargo piping, cargo transfer hoses, cargo pumps and valves.

Some hazards included were difficult to determine and have been included to make the recommendation complete. The identified hazards be divided into two main categories:

- construction and design (e.g. piping not properly supported, material not resistant to corrosion, valves not fire-rated); and
- operational conditions (e.g. cargo pumps leaking, cargo transfer hoses damaged, pipes and hoses not regularly pressure tested, no maintenance records).

These hazards can lead to spillage of dangerous goods causing harm to the environment, fire or explosion when the spilled product ignites, putting employees and local communities at risk.

References

- *ANSI, Process Piping, B31.3, 1996;*
- *API Pub. 1637, Color-Symbol System To Mark Equipment and Vehicles For Product Identification at Service Stations and Distribution Terminals;*
- *EN 1765: 2005 and BS 1435-2: 2005, Rubber Hose Assemblies for Oil Suction and Discharging Services;*

- *OISD-STD-135, Inspection of Loading and Unloading Hoses for Petroleum Products; and*
- *International Safety Guide for Inland Navigation Tank-Barges and Terminals (ISGINNT).*

ACTIONS
Technical and Management

Loading Arms, Cargo Pipes and Transfer Hoses

Loading arm installations should have a visual indication of the operating envelope and/or be provided with alarms to indicate excessive range and drift.

Loading arms, cargo pipes and transfer hoses should be conform to recognised standards and be used only for substances for which they are suitable with regard to temperature, compatibility of substances and working pressure or flow rate.

All new and replacement piping must be designed, fabricated, tested and maintained in accordance with codes of practice developed by a recognised association. Piping must be tested for tightness and all deficiencies must be eliminated before the piping is placed in service.

All cargo transfer hoses (see Figure 2) and piping must be adequately supported and protected from physical damage caused by vehicular traffic. Piping must be painted or coated according to recognised industrial standards to prevent corrosion.

For identification purposes, all piping at terminal facilities must be colour-coded.

Transfer piping spill containment to be provided. All oil transfer points of connection must be provided with a spill containment system designed, constructed and maintained to contain discharges that may occur from a hose or connection point rupture.

All piping must be tested for tightness. Tightness testing is required for piping 10 years after installation and every 5 years thereafter.

All terminal facility transfer hoses must be marked with the following information:

- manufacturer's name or trademark;
- identification with the standard specification of manufacture;
- products for which the hose may be used – or the marking for oil service;
- maximum allowable working pressure;
- month and year of manufacture;
- manufacturer's serial number; and
- date of last test.

Hose ends must be blanked tightly when hoses are moved into position to be connected and also immediately after they are disconnected and drained either into the vessel tanks or into suitable shore receptacles before they are moved away from their connection.

Transfer hoses must be hydrostatically tested annually to 1.5 times the maximum allowable working pressure to check their integrity. Electrical continuity test should be performed before, during and after the pressure test.

ACTIONS
Technical and Management (continued)

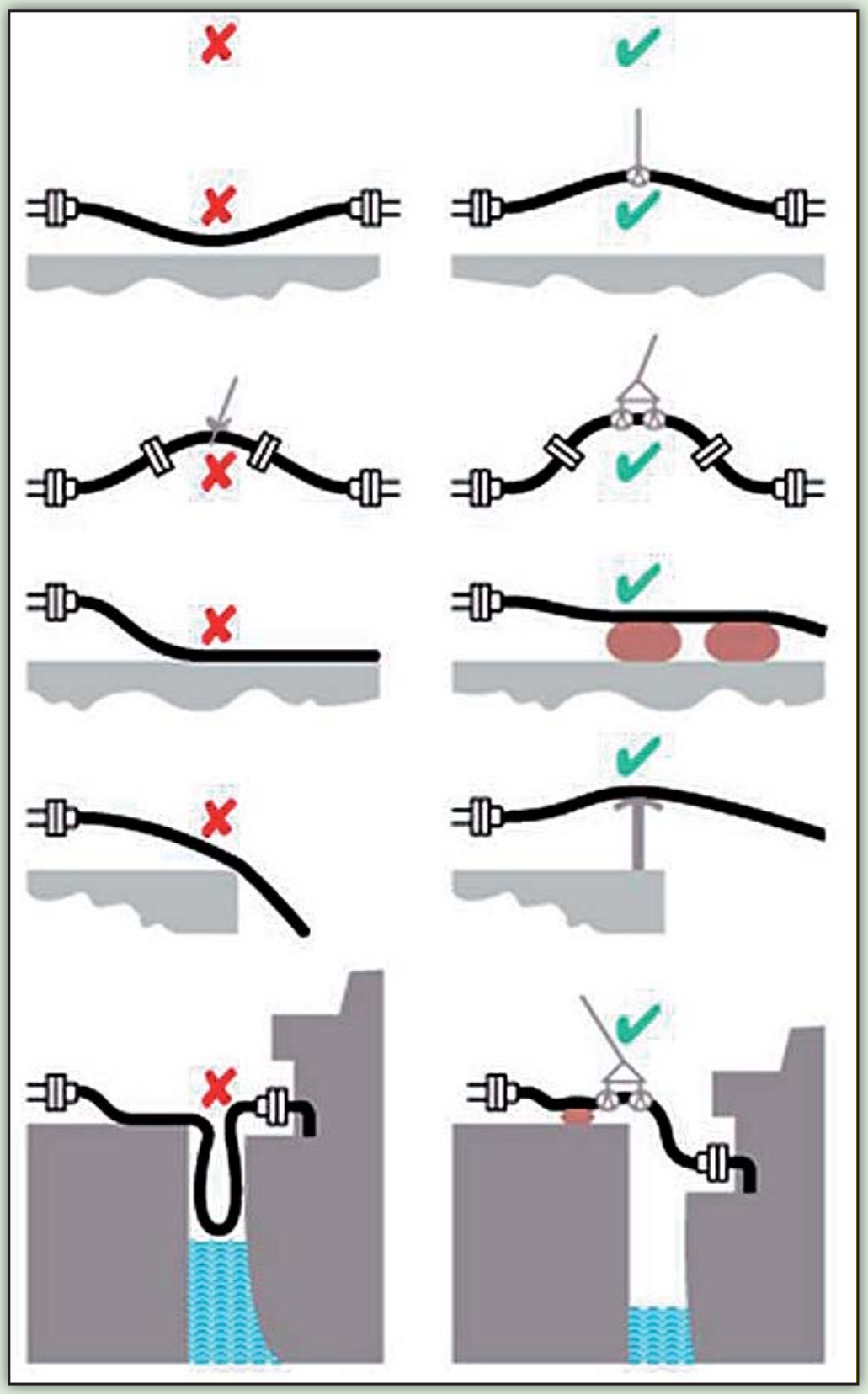

Figure 9: **Supporting the Cargo Hose**

ACTIONS
Technical and Management (continued)

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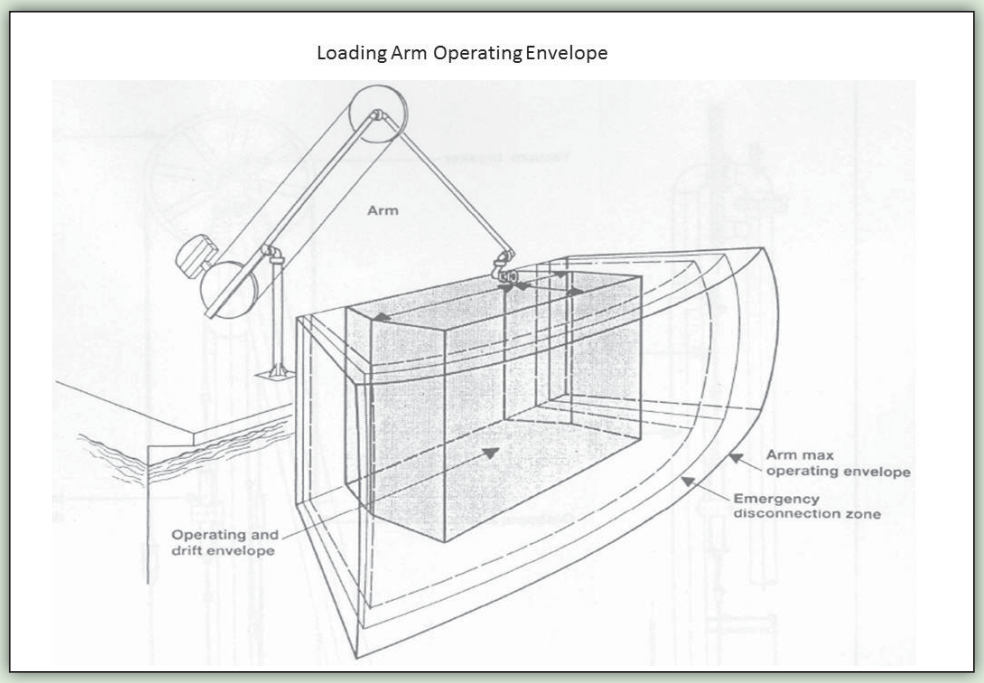


Figure 10: **Loading Arm Envelope**

Cargo Valves

Fire-safe shut-off valves should be fitted close to each tank on both inlet and outlet pipes. These valves should conform to an international standard (for example, BS EN ISO 10497) or be of an intrinsically fire-safe design, not constructed of cast iron or wafer bolted.

Motorised valve closure time should be in the order of 30 seconds, preferably more in order to avoid surge pressure in the cargo piping and transfer hoses.

Cargo Pumps

Cargo transfer pumps must be equipped with secondary containment to catch leaks from bearings, packing and seals.

Adequate procedures should be made for:

- operations, supervision and connecting/disconnecting of loading arms and, in the event of an emergency, protecting the environment, personnel safety and equipment;
- visual inspection for cracks, leaks and wet spots prior to commencing loading/discharging operations of cargo pipes, hoses, valves, joints and flanges. Records of these inspections to be kept at the facility;
- inspection/testing and maintenance of cargo transfer equipment. Records of inspection/testing and maintenance to kept at the facility; and
- checklist to be filled prior to using the cargo transfer equipment.

An inventory of all cargo transfer hoses should be made indicating products for which they may be used, maximum allowable working pressure, date of manufacture and date of last pressure test.

Institutional and Capacity Building

Relevant line agencies have to determine:

- minimum design and construction standards for cargo pipes, hoses and valves to be complied with;
- minimum requirements for valves and fittings;
- testing procedures for cargo pipes and hoses; and
- standards for documenting testing procedures.

Training programmes for relevant line agencies should be developed resulting in thorough knowledge of the above-mentioned minimum requirements.

Proper training should be provided for personnel in charge of operating and handling cargo transfer equipment and carrying out maintenance at ports and terminals.

2.3.2.4 Level Gauges, Capacity Alarms and Overfill Prevention

Member countries should determine minimum standards for the operation, testing and maintenance of level gauges, capacity alarms and overfill prevention systems to ensure they are functioning adequately.

Challenge

In some terminals, level gauges are not regularly inspected or tested. In others, records of tests are not available. Level gauges and capacity alarms are critical equipment for terminals. Level gauges monitor the level of the fuel in the tank as it fills/empties and are used to determine if the filling rate of the tank is according the predetermined filling rate. Level gauges can also be used to determine if the tank level remains fixed if no operations are carried out. Tank capacity alarms indicate that the tank is filled to a maximum allowable level and trigger a high-level switch that shuts off the supply to the tank. Failure can lead to an overflow of product (loss of primary containment) and result in a fire or explosion if the vapours are ignited. The importance of the level gauges, capacity alarms and overfill prevention system can be illustrated by the disastrous consequences of the Buncefield fire in Britain in 2005 which was caused primarily by the failure of the level gauges and a high-level switch.

References

- *IEC 61511: Functional Safety–Safety Instrumented Systems for the Process Industry Sector;*
- *API 2350: Overfill Protection for Petroleum Storage Tanks; and*
- *Safety and Environmental Standards for Fuel Storage Sites, Process Safety Leadership Group – Final Report, HSE 2009.*

ACTIONS
Technical and Management

Tank-level instrumentation and information-display systems should be of sufficient accuracy and clarity to ensure safe planning and control of product transfer.

The overall systems for tank-filling control should be of high integrity, with sufficient independence to ensure timely and safe shutdown to prevent tank overflow (see Figure 11).

The following independent overfilling level alarms should present:

- high-liquid-level alarm with audible and visual signals. The alarm should allow sufficient time for a response following activation that will prevent the level rising to the tank rated capacity (or the high-high-level activation point if this is set lower); and
- high-high-liquid-level alarm with audible and visual signals should be set at or below the tank rated capacity. The alarm should allow sufficient time for a response following activation that will prevent the level rising to the overfill level (maximum) capacity.

Figure 11: **Overfilling Protection: Tank Levels (based on API 2350)**[1]

[1] Safety and Environmental Standards for Fuel Storage Sites, Process Safety Leadership Group - Final Report

ACTIONS
Technical and Management (continued)

Protection against loss of containment of product can be achieved by fitting a high-integrity, automatic overfill-prevention that is system physically and electrically separate and independent from the tank level gauging system.

Overfill-protection systems must be tested before each transfer or monthly, whichever is the least frequent.

Procedures should be developed for monitoring and controlling of levels and protection against overfill. These procedures may include but are not limited to:

- calculation of spare capacity;
- correct valve lineup;
- cross-check of valve lineup;
- manual dipping of tanks to check automatic tank-gauging calibration;
- confirmation that the correct tank is loaded/discharged;
- monitoring level increase/decrease in the correct tank during filling;
- checks for no increase/decrease in levels static tanks;
- closing valves at the end of a transfer; and
- response to level alarm high (LAH) and response to level alarm high-high (LAHH).

Procedures should be developed for maintenance and periodic proof testing of storage tank overfill-prevention systems to ensure their continuing integrity in operation and to minimise the likelihood of any failure that could result in loss of containment. Documented records of maintenance and inspections/tests should be kept at the facility.

Institutional and Capacity Building

Relevant line agencies should determine minimum standards for equipment that protect against loss of primary containment.

Protection against overfill may depend on operators taking the correct actions at a number of stages in the tank-filling process so they should be competent in performing their tasks consistently to the required standards. Relevant line agencies should develop minimum standards for training operators to ensure they have the necessary knowledge, understanding and skills to perform their tasks.

Terminal operators should develop adequate procedures to ensure the liquid level in storage tanks is gauged at regular intervals and that the results are compared to those of the previous readings. A record of the measurements must be maintained at the facility.

2.3.2.5 Fire and Gas Detection Equipment and System Alarms

RECOMMENDATION
Member Countries should determine minimum standards for the installation, maintenance and testing of fire and gas-detection equipment to ensure they are functioning properly.

Challenge

Fire detection equipment is not always inspected/tested regularly or there are no records of testing/ inspection available. Only a limited number of ports and terminals included in the risk assessment had gas-detection systems in place and even fewer ports had fire-detection systems in place.

Fire and gas-detection equipment are key to maintaining the overall safety and operation of ports/terminals. The equipment continuously monitors for abnormal situations such as fire and the release of combustible or toxic gases within the terminal/port, providing an early warning to prevent escalation of the incident and protect the process or environment. Fire and gas-detection equipment can detect early warnings of explosive and health hazards, including combustible and toxic-gas releases, thermal radiation from fires and traces of smoke. They provide audible and visual alarms to ensure that operators and personnel are informed of potentially hazardous situations, allowing for immediate actions to minimise escalation of safety incidents, protecting personnel, property and the environment.

References

- *International Safety Guide for Inland Navigation Tank-Barges and Terminals (ISGINNT);*
- *NFPA 30, Flammable and Combustible Liquids Code; and*
- *Handbook of Fire and Explosions Protection Engineering Principles for Oil, Gas, Chemical and Related Facilities*[2].

ACTIONS
Technical and Management

The selection and fitting of fire-detection equipment and alarm systems at a terminal or port depend on several factors including:

- products being handled;
- size and quantity of the vessels/barges berthed per year;
- terminal throughput;
- pumping rate; and
- proximity to residential, commercial or other industrial properties.

Before installation, the advice from manufacturers and fire-safety experts should be considered, along with a compliance check against applicable regulations.

When planning a fire detection system, detectors should be selected based on the type of fires that can occur. The following should be taken into consideration:

- type and quantity of fuel handled;
- possible ignition sources;
- range of ambient conditions; and
- value of the property.

Fixed combustible gas sensors should be placed in areas sensitive to hydrocarbon leaks or spills (e.g. loading arm areas, near valve manifolds and near transfer pumps) or areas that contain ignition sources. Fixed toxic-gas sensors may be installed in supply air intakes of cargo control rooms. Fire and gas detection equipment should be periodically tested to ensure reliable operation.

The alarm system should have the capability to automatically self test and warn of malfunctioning and to raise local audible and visual alarms and, depending on the circumstances. a general alarm. It should indicate an alarm on a fire-control panel indicating the location of the activated sensor.

[2] Noyes publications, Dennis P. Nolan, P.E., 1996

Institutional and Capacity Building

Relevant line agencies should conduct inspections to determine if terminals or ports have adequate fire and gas-detection equipment

Personnel responsible for the fire-detection equipment should be competent and familiar with the specific equipment installed. All terminal personnel should be trained and able to recognise the fire alarm signal.

Maintenance and testing should be done by a competent person.

2.3.2.6 Electrical Equipment

RECOMMENDATION
Member countries should determine minimum standards for electrical equipment (fixed and portable) used at ports and terminals.

Challenge

Electrical installations and equipment are often not suitable for industrial operations. Only one terminal included in the risk register noted the use of hazardous zones. At smaller ports, where basic small-scale fuel-transfer operations are carried, out some hazardous electrical connections were established. Some vessels moored at terminals have naked lights on deck.

The National Working Groups did not have the specific knowledge and equipment available to determine if all electrical installations are according to standards so this recommendation has been included. In normal use, electrical equipment often creates tiny internal sparks in switches, motor brushes, connectors and other places. Such sparks can ignite flammable substances present in the air. An intrinsically safe device is designed to contain no components that produce sparks or which can hold enough energy to produce a spark of sufficient energy to cause an ignition. The integrity of the protection afforded by the design of explosion-proof or intrinsically-safe electrical equipment may be compromised by incorrect maintenance procedures.

References

- *International Safety Guide for Inland Navigation Tank-Barges and Terminals;*
- *IEC 60079- Electrical Apparatus for Explosive Gas Atmospheres;*
  - *Part 10 Classification of Hazardous Areas;*
  - *Part 14 Installation (and Selection) of Equipment in Hazardous Areas; and*
  - *Part 17 Inspection and Maintenance of Equipment.*

ACTIONS
Technical and Management

At a terminal, the probability of a flammable gas mixture being present is taken into account by grading hazardous areas into three zones. The International Electrotechnical Commission[3] classifies hazardous areas into zones based upon the frequency of the occurrence and duration of an explosive gas atmosphere as follows:

[3] Thailand is full a IEC member, Viet Nam is an associate IEC member and Cambodia and Lao PDR are IEC affiliate country programme participants

ACTIONS
Technical and Management (continued)

- **Zone 0:**

  A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously or for long periods or frequently.

  - Flammable atmosphere highly likely to be present - may be present for long periods or even continuously.

- **Zone 1:**

  A place in which an explosive atmosphere consisting of a mixture with air or flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally.

  - *Flammable atmosphere possible but unlikely to be present for long periods.*

- **Zone 2:**

  A place in which an explosive atmosphere consisting of a mixture with air or flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will only persist for a short period.

  - *Flammable atmosphere unlikely to be present except for short periods of time - typically as a result of a process fault condition*.

Terminals should ensure that any electrical equipment is provided in accordance with a site-specific area electrical drawing, which shows hazardous zones at the cargo transfer areas in plan and elevation.

Terminals should identify the zones and establish the type of equipment that is to be installed within each zone. National legislation, international standards and company-specific guidelines, where available, are all to be complied with.

All portable electrical equipment for operation in hazardous areas, including lamps and communications equipment, must be of an approved type for use in flammable atmospheres. Before use, portable equipment should be examined for possible defects such as damaged insulation and a check made that cables are securely attached and that they will remain so throughout the work. Special care should be taken to prevent any mechanical damage to flexible cables or wandering leads. Any other electrical or electronic equipment of a non-approved type, whether mains or battery powered, must not be active, switched on or used within hazardous areas. This includes, but should not be limited to, radios, calculators, photographic equipment, laptop computers, handheld computers and any other portable equipment that is electrically powered but not approved for operation in hazardous areas.

A planned maintenance system should be implemented addressing the continued integrity of the equipment installed, and ensure it remains able to meet zone requirements.

A permit to work system should be developed so all electrical maintenance is carried out under the control of this system.

Institutional and Capacity Building

Personnel carrying out maintenance on equipment within hazardous zones should be trained and certified as competent to carry out the work.

2.3.3 Sustaining Operational Performance and Integrity

2.3.3.1 Inspections and Testing of Critical Equipment

RECOMMENDATION
Member countries should determine minimum standards for the operation and maintenance of critical equipment, which should be regularly inspected and tested by terminal and port management and external authorities where required.

CHALLENGE

The risk analysis determined that not all equipment is regularly tested and inspected, and that records of inspections and tests are not well documented. The National Working Groups also determined that some terminals have no or limited procedures for inspections and tests to be carried out.

The purpose of an Inspections and Test Plan is to put together a single document that records all inspection and testing requirements relevant to the critical equipment of a specific terminal/port. An Inspection and Test Plan identifies the equipment or process to be inspected or tested, by whom and at what stage or frequency, references to relevant standards, acceptance criteria and the records to be maintained. The purpose of Inspection and Test Plans, when properly implemented, is to prevent, predict and readily detect equipment failure, and help to ensure and verify whether equipment is working according to applicable standards and requirements.

The person who carries out the test and inspection must be competent, skilled and have experience with the type of installation/equipment.

References

- *Maintenance Management System for Upstream Operations in Oil and Gas Industry: Case Study, World Academy of Science, Engineering and Technology 60, 2009.*
- *Management of Process Hazards, API Recommended Practice 750.*

ACTIONS
Technical and Management

Inspection and testing programmes for critical equipment should be developed. This programme should include:

- a complete list of all critical equipment and systems that are subject to testing and inspection. This list should include but be not limited to pressure vessels, storage tanks, critical piping and hoses, relief systems and devices, emergency-shutdown systems, critical alarms, high-level alarms and interlocks, safety equipment, oil-spill equipment and critical- detection equipment. The list should include and specify the method and frequency of testing and inspection, acceptable limits and criteria for passing a specific test or inspection;
- testing and inspection procedures that follow commonly accepted standards and codes;
- documentation of completed testing and inspection. In general, to assist in determining any needed changes in the frequency of testing, inspection and preventative maintenance, documentation should be retained for the life of the equipment;
- procedures to correct equipment deficiencies or operations that are outside acceptable limits; and
- a system for reviewing and authorising changes in tests and inspections.

ACTIONS
Technical and Management (continued)

Inspections and tests should be be carried out by competent and skilled personnel.

Training should be provided for carrying out inspections and tests.

Institutional and Capacity Building

Relevant line agencies should establish frequency and minimum standards for inspection and testing of critical equipment and determine minimum standards of competence for personnel carrying out inspections and tests.

Competent authorities should verify that all critical equipment is tested according to established frequency and minimum standards.

2.3.3.2 Maintenance of Critical Equipment

RECOMMENDATION
Member countries should determine minimum standards for a planned maintenance system for critical equipment.

Challenge

In some cases, maintenance of equipment in ports/terminals is reduced to "break down" maintenance instead of a preventive and predictive maintenance schedule. Breakdown maintenance or poorly maintained equipment can lead to:

- increased downtime during cargo operation and costly stoppages for repair;
- impact on health and safety, e.g. fire, personnel injury and health hazard;
- impact on the environment, e.g. release of toxic gas; and
- impact on port/terminal facilities (e.g. fire and explosion).

Maintenance is a combination of all technical, administrative, and managerial actions during the life cycle of equipment intended to keep it or restore it to a state in which it can perform the required function[4]. The main objective of a good maintenance management system is to reduce the reactive maintenance to a minimum by implementing a cost-effective proactive maintenance strategy. Implementing a good maintenance policy will increase the integrity and reliability of equipment, reduce unplanned breakdown of equipment and reduce maintenance costs by avoiding unnecessary equipment dismantling and extend the lifespan of equipment. A good maintenance policy will result in high productivity and an increased level of safety.

References

- *Maintenance Management System for Upstream Operations in Oil and Gas Industry: Case Study, World Academy of Science, Engineering and Technology 60, 2009; and*
- *OISD Recommended Practice-124, Predictive Maintenance Practices, Revised Edition August 2007.*

[4] A cost model of industrial maintenance for profitability analysis and benchmarking, International Journal of Production Economy, Komomen, K., 2002

ACTIONS
Technical and Management

A maintenance policy system should include:

- Identification of all equipment subject to maintenance, including:
  - ✓ cargo handling/transfer equipment (e.g. valves, pumps, pipes);
  - ✓ electrical equipment;
  - ✓ lifting equipment (cranes, chain blocks, electric winches);
  - ✓ portable equipment (gas detection equipment, oxygen meters);
  - ✓ firefighting equipment (e.g. extinguishers, fire hoses, fire pumps);
  - ✓ oil spill equipment (e.g. skimmers, booms, etc); and
  - ✓ emergency response equipment.

Maintenance procedures/methodology should be according manufacturer's recommendations, recognised international standards, recommended practices/guidelines and follow generally-accepted good engineering practices. Documented step-by step methods to carry out maintenance, spare parts material and tools to be used for maintenance should be provided. History and records of trend analysis of equipment should be taken in consideration. The procedures should include:

- safety aspects regarding maintenance (system of permit to work, use of personnel protective equipment [PPE]);
- defining the task, role and responsibilities of persons carrying out maintenance work;
- authorization of maintenance procedures;
- a regular-certified, updated and approved maintenance manual to be developed; and
- procedures for recording maintenance carried out.

Institutional and Capacity Building

Maintenance of critical items should be carried out only by experienced and competent personnel familiar with the port/terminal equipment.

2.3.4 Health, Safety and Environmental (HSE) Management

2.3.4.1 Establishing HSE Management System

RECOMMENDATIONS
Member countries should ensure that port and terminal operators establish a HSE management system and submit safety and environmental management and monitoring plans to the relevant line agencies.

Challenge

All ports and terminals should establish health, safety and environment management (HSE) systems in order to ensure safety in the port, the prevention of human injury or loss of life, and the avoidance of damage to the environment, to property and to cargo. HSE management systems were not established at all of the ports and terminals included in the Risk Analysis.

References

ILO Code of Practice on Safety and Health in Ports, 2005

The practical recommendations in this code are intended to provide valuable advice and assistance to all those charged with the management, operation, maintenance and development of ports and their safety. The code ILO code will help to raise the profile of safety and health issues in ports. While the code looks to the future by including a methodology for considering innovations, it retains advice on older conventional methods as well. New topics, which were not included in the previous publications, are: traffic and vehicular movements of all types; activities on shore and on ship; amended levels of lighting provision; personal protective equipment; ergonomics; provisions for disabled persons; and the specific handling of certain cargoes, for example logs, scrap metal and dangerous goods[5].

Despite new and sophisticated innovations, port work is still considered an occupation with very high accident rates. Every port, in light of its specific circumstances, needs to develop working practices that safeguard the safety and health of portworkers. This essential code of practice, intended to replace both the second edition of the ILO Code of Practice on Safety and Health in Dock Work (1977) and the ILO Guide to Safety and Health in Dock Work (1976), provides valuable advice and assistance to all those charged with the management, operation, maintenance and development of ports and their safety.

Offering many detailed technical illustrations and examples of good practice, the provisions of this code cover all aspects of port work where goods or passengers are loaded or unloaded to or from ships, including work incidental to such loading and unloading activities in the port area. It is not limited to international trade but applies equally to domestic operations, including those on inland waterways.

While the code looks to the future by including a methodology for considering innovations, it retains advice on older conventional methods as well. New topics, which were not included in the previous publications, are: traffic and vehicular movements of all types; activities on shore and on ship; amended levels of lighting provision; personal protective equipment; ergonomics; provisions for disabled persons; and the specific handling of certain cargoes, for example logs, scrap metal and dangerous goods.

PEMSEA

The Partnerships in the Environmental Management for the Seas of East Asia (PEMSEA) is an international organization established by 11 countries (Cambodia, China, North Korea, Indonesia, Japan, Lao PDR, Philippines, South Korea, Singapore, Thailand, Timor-Leste and Vietnam) in the East Asia region and is a partnership arrangement involving various stakeholders of the Seas of East Asia, including national and local governments, civil society, the private sector, research and education institutions, communities, international agencies, regional programmes, financial institutions and donors.

Recognizing that there are no international standards covering safety, health and environmental (SHE) management aspects of port operations, PEMSEA has developed the Port Safety Health and Environmental Management (PSHEM) Code. The PSHEM code is for voluntary use by port authorities and those companies operating in the port whose activities may have effect on health and safety of people, the environment and port installations.

The Code has been successfully demonstrated at the port of Tanjung Pelepas (Malaysia), Bangkok Port and Leam Chabang Port (Thailand). The PSHEM code developed in these ports achieved the following results:

[5] http://www.ilo.org/global/publications/ilo-bookstore/order-online/books/WCMS_PUBL_9221152871_EN/lang--en/index.htm

References

- *Improved operational business efficiency and cost savings;*
- *Reduction in accidents and resulting environmental damages;*
- *Improved system of safety, health and environmental governance to control private terminal operators;*
- *Improved handling of dangerous cargoes and waste materials; and*
- *Reduction of safety, health and environmental risk through improved access control in port.*
- *Port Safety Health and Environmental Management System (PSHEMS) Code; and*
- *ILO Code of Practice on Safety and Health in ports, 2005.*

ACTIONS

Technical and Management

Ports and terminals should develop HSE management systems. The main goals of this HSE management system are to

- Provide the framework and tools to manage evolving HSE issues quickly and easily;
- Prevent injuries of employees, contractors or visitors;
- Prevent damage to equipment; and
- Prevent harm to the environment.

Institutional and Capacity Building

Member Countries and port authorities should ensure that port and terminal operators develop a HSE management system.

Training courses for implementing and auditing a PHEMS to be provided.

2.3.4.2 Segregation and Storage of Dangerous Goods

RECOMMENDATION

Member countries should determine minimum standards for the storage and segregation of dangerous goods.

Challenge

At some ports, dangerous goods are not properly segregated or there are no designated areas for storing dangerous goods. Failure to segregate dangerous goods properly can result in a violent chemical reaction with other dangerous goods which can lead to fire, explosion or release of toxic vapours and injury to personnel. The National Working Groups determined that there is a general need for training regarding the storage and handling of dangerous goods. Insufficient training can lead to misjudgment of hazards relating to dangerous goods, increasing the risk of accidents/personal injury.

Storage and segregation of dangerous goods is critical. Major incidents have already occurred because non-compatible dangerous goods were stored next to or on top of each other and, in turn, reacted violently. Generally, different classes of dangerous goods should be stored separately, at least 3 m apart, and in some situations stored in different rooms. Bunding must be provided and storage areas must be clean, tidy and free of flammable materials, well ventilated and have appropriate emergency spill kits and firefighting equipment.

For the segregation table the following division of classes according IMDG code is used:

- Class 1 Explosives
- Class 2.1 Flammable Gases
- Class 2.2 Non-Toxic, Non-Flammable Gases
- Class 2.3 Toxic Gases
- Class 3 Flammable Liquids
- Class 4.1 Flammable Solids
- Class 4.2 Spontaneously Combustible Substances
- Class 4.3 Substances Which, in Contact with Water, Emit Flammable Gases
- Class 5.1 Oxidising Substances
- Class 5.2 Organic Peroxides
- Class 6.1 Toxic Substances (Liquids and Solids)
- Class 6.2 Infectious Substances
- Class 7 Radioactive Material
- Class 8 Corrosives (Liquids and Solids)
- Class 9 Miscellaneous Dangerous Substances and Articles

References

- *Dangerous Goods Safety Guidance Note S02/09, Risk Assessment for Dangerous goods, Government of Western Australia, December 2009; and*
- *International Maritime Dangerous Goods Code, Volume 1-2.*

ACTIONS
Technical and Management

Dangerous goods cargo areas should have separate areas with all necessary facilities appropriate to the intrinsic hazardous properties of the dangerous goods that are stored. These facilities should be provided with separate ventilation, drainage, fire resistant wall and ceilings etc.

Dangerous goods cargo areas should, where possible, be located so that management and/or security personnel may keep them under continuous observation. Otherwise, an alarm system may be provided or the spaces inspected at frequent intervals.

All dangerous goods delivered in the port area should be marked, documented, packaged and labelled or placarded in accordance with the IMDG Code.

If no general segregation is required, the individual requirements of the Dangerous Goods Lost IMDG Code shall be consulted.

A recommended intermodal shipping document should be used for dangerous goods. This document should contain such information as needed for accurately booking, transporting and describing dangerous goods in a paper or electronically-transmitted document that could be used for highway, rail and vessel transport and intermodal transfers in international commerce.

ACTIONS
Technical and Management (continued)

For container stacking areas and lorry parking areas, separate areas should be designated for the storage of dangerous goods. These areas should provide sufficient space for segregation and provide adequate access to the dangerous cargoes kept in that area and access lanes for handling equipment such as lit trucks.

Care should be taken that, in case of emergency, adequate access is provided for handling emergency service equipment etc.

Dangerous goods areas should be provided with adequate emergency facilities.

Special areas for damaged dangerous cargoes and waste contaminated with dangerous cargoes should be provided.

Dangerous goods areas should, where appropriate, be covered, have a sealed floor or ground, separate drainage systems with shut-off valves, sumps or basins and means to discharge contaminated water to special facilities in order to safeguard the environment.

Institutional and Capacity Building

All shore-based personnel should receive:

- general awareness/familiarisation training designed to provide familiarity with the general hazards of relevant dangerous cargoes and the legal requirements. Such training should include a description of the types and classes of dangerous goods, marking, labelling and placarding, packing, segregation and compatibility requirements, a description of the purpose and content of the transport documents and a description of available emergency documents.
- function-specific training concerning specific requirements for the storage and handling of dangerous goods which are applicable to the function of the trainee.
- safety training corresponding to the risk in the event of a release of dangerous cargoes and the function of the trainee, this training should include:
    - methods and procedures for accident avoidance, such as proper use of package-handling equipment and appropriate methods of stowage and segregation of dangerous goods;
    - necessary emergency response information and how to use it;
    - general dangers of the various types and classes of dangerous cargoes and how to prevent exposure to their hazards including the use of Personal Protective Equipment (PPE); and
    - immediate procedures to be followed in the event of an unintentional release of dangerous cargoes, including any emergency procedure for which the person is responsible and the personal protection procedures to be followed.

Training described above should be periodically supplemented with retraining.

Relevant line agencies should determine minimum training and retraining standards for all personnel involved in the storage and handling of dangerous goods.

2.3.4.3 Monitoring and Control of Dangerous Goods

RECOMMENDATION
Member countries should determine minimum standards for the monitoring and control of dangerous goods, including dangerous goods register and Material Safety Data Sheets (MSDS).

Challenge

Not all ports/terminals keep a register of all dangerous goods on the premises. Sometimes, the register is not updated or Material Safety Data Sheets (MSDS) of these dangerous goods are not always readily available. Having a dangerous goods register and the relevant MSDS is as equally important for terminals where dangerous goods in bulk are handled/stored as for ports storing packaged dangerous goods in warehouse and terminal areas as for ports storing containers with dangerous goods. In the event of an emergency, not having a dangerous goods register can lead to a delayed response resulting in an escalation of the incident. The dangerous goods register with the adjoining MSDS are part of the emergency plan and must be readily accessible to any employee at the premises and any other person who is likely to be affected by the dangerous goods on the premises.

An MSDS is a document that contains information for the safe handling, use, storage and disposal of dangerous goods. MSDS should be provided by the supplier of the dangerous goods. The port/terminal must make sure an authorised version of the MSDS is supplied. Generic MSDS should not be accepted, although the data from generic MSDS can be used as supplementary information. The information contained in the MSDS will enable employees and emergency services personnel to deal with incidents such as spillages and damaged packages. MSDS should be readily accessible to all employees, other personnel on the premises, emergency services, medical personnel and other authority personnel. Manufacturers of dangerous goods are required to review and, where necessary, revise MSDS every 5 years so attention should be paid that the issue dates of the MSDS should be within the last 5 years.

The sites below contain Material Safety Data Sheets which free for consultation and need no registration:

1. http://www.msds.com/
2. http://www.msdsxchange.com/english/index.cfm
3. http://hazard.com/msds/index.php

References

- *Code of Practice for the Storage and Handling of Dangerous Goods, No. 27, 8 December 2000;*
- *Manifests for Dangerous Goods Storage, Chemical Management and Emergency Management (CHEM) Services, January 2002;*
- *International Maritime Dangerous Goods Code, Volume 1-2; and*
- *Dangerous Goods Safety Guidance Note S02/09, Risk Assessment for Dangerous Goods, December 2009, Government of Western Australia, Department Mines and Petroleum,*

Resource Safety.

ACTIONS
Technical and Management

Authorised version of MSDS should be provided by the supplier of the dangerous goods. The issue date should be within the last five years. MSDS should be readily accessible to all employees and emergency services authority personnel.

A dangerous goods register contain but not be limited to:

- list of all dangerous goods and combustible liquids stored and handled on the site;
- exact name of the dangerous goods;
- manufacturer;
- quantity present on the facility;
- storage location and site plan
- dangerous goods class and subclass (if applicable);
- name of the person responsible for maintaining the register; and
- MSDS of the dangerous goods.

Institutional and Capacity Building

Relevant line agencies should make a dangerous goods register and MSDS compulsory for facilities storing dangerous goods.

2.3.4.4 Checklists for Critical Operations

RECOMMENDATION
Port and terminal operators should ensure that procedures and checklists are developed for critical operations.

Challenge

Procedures and checklists have not been developed for critical operations at ports and terminals. A checklist is a mnemonic list of items that need to verified, checked or inspected before an action or operation is carried out. A checklist contains a detailed number of predetermined questions and tick boxes to be completed. The main purpose is to reduce the chance that critical items are forgotten. A procedure is a detailed step-by-step description to be followed to complete a task successfully. Examples of critical operations: maintenance to be carried out, lifting operations, work at heights and work over water.

The appendices of the ISGINTT contain samples of checklists for the following operations:

- Appendix 1 : Tanker-Shore Safety Checklist;
- Appendix 2 : Seagoing – Inland Tanker/Inland Tanker Safety Checklist;
- Appendix 3 : Hazardous Disposal Safety Checklist;
- Appendix 4 : Non-Hazardous Disposal Safety Checklist;
- Appendix 5 : Bunkering Safety Checklist for Bunker Delivery to Inland Ships;
- Appendix 6 : Bunkering Safety Checklist for Bunker Delivery to Maritime Ships; and
- Appendix 7 : Guidelines for Completing the Safety Checklist.

References

International Safety Guide for Inland Navigation Tank-barges and Terminals (ISGINTT).

ACTIONS
Technical and Management

Procedures and checklists to be developed for critical operations in ports and terminals.

Institutional and Capacity Building

Port regulations to include the use of an approved safety checklist before starting cargo transfer or bunkering operations.

Personnel completing the checklist should be competent and familiar with all items to be verified, checked or inspected before signing for approval.

2.3.4.5 Waste Management

RECOMMENDATION
Member Countries should determine minimum standards for waste-management systems and waste-reception facilities at ports.

Challenge

Ports and terminals have not developed waste-management plans and have very limited waste-reception facilities for waste generated by vessels. Only one country had the possibility of a third party collecting waste generated by vessels. Not having a waste-management plan or waste-reception facilities may lead to the illegal disposal of liquid and solid waste into the Mekong River, causing harm to the environment, putting public health at risk and even causing damage to property.

Although essential contributors of aquatic pollution come from land-based sources, a significant amount is caused by shipping and inland water activities, generally vessel and port waste. The pollution of the aquatic environment is a matter of increasing concern.

The main objective of a waste-management plan is reducing and ultimately eliminating intentional pollution of the aquatic environment by reducing discharges of port/vessel-generated wastes, cargo residues and other substances harmful for the aquatic environment.

The type and quantity of solid and liquid wastes associated with port operations may vary significantly and depend on the port operations and the type of vessels calling at the port. Ports and terminals mainly have two kinds of waste to deal with:

1. Waste generated by the port/terminal including:
   - solid waste from cargo packages;
   - solid waste from administrative offices; and
   - waste associated with vehicle and equipment maintenance (used lubricating oils and engine-degreasing solvents).

2. Waste generated by ships including:
   - oily waste from machinery (bilge water) and cargo/ballast operations; and
   - garbage.

ACTIONS
Technical and Management

Waste-management plans for port must address:

- a summary of the relevant legislation and official regulations for delivery;
- identification of a person who is responsible for the implementation of the port waste-management plan;
- assessment of the need for port-reception facilities meeting the need of the ships normally visiting the port;
- examining the type and amounts of waste and cargo residues delivered in the port;
- a description of the treatment equipment and processes in port;
- a description of the type and capacity for port-reception facilities;
- a detailed description of the procedures for the reception and collection of ship-generated waste and cargo residues;
- a description of how the ship-generated waste and cargo residues are disposed of;
- a description of methods of recording use of the port-reception facilities;
- a description of methods recording amounts of ship-generated waste and cargo residues received in the reception facilities;
- description of the charging system;
- procedures for reporting inadequacies of port-reception facilities; and
- procedures for consulting with port users, waste contractors, terminal operators and other interested parties in the city management context.

In addition, plans should include:

- reference to proper delivery of ship-generated waste and cargo residues;
- location of port-reception facilities shown on the diagram, and map of the port;
- information on the groups of ship-generated waste and cargo residues, which cannot be disposed into the river and which have to be delivered to the port-reception facilities;
- a description of the waste-sorting system;
- a list of ship-generated waste and cargo residues dealt with in the port;
- a list of contact persons, operators and services offered; and
- a description of procedures for waste delivery.

Institutional and Capacity Building

Relevant line agencies should develop a port-waste management system and an awareness programme on environmental protection and waste management.

2.3.4.6 Drug and Alcohol Policy

RECOMMENDATION
Port and terminal operators should develop a drug and alcohol policy.

Challenge

A number of ports and terminals do not have specific policy for drugs and alcohol.

Port/terminal operators should take drug and alcohol abuse as a serious matter and absolutely prohibit the use, sale or possession of alcohol or non-prescribed drugs while on the port/terminal premises. Port and terminal operators should reserve the right to demand a drug or alcohol test of any employee at any time or based upon reasonable suspicion. Reasonable suspicion includes, but is not limited to, physical evidence of use, involvement in an accident or a substantial drop-off in work performance. Port and terminal operators should also caution against use of prescribed or over-the-counter medication which can affect the ability of personnel of performing their job properly and safely.

References

Guidelines for the Control of Drugs and Alcohol Onboard Ship, OCIMF, June 1995.

ACTIONS
Technical and Management

Ports and terminals should have a clearly written policy on drugs and alcohol abuse that is easily understood by all personnel. The policy should be clearly communicated to all personnel. Furthermore, to enforce their policy, companies should have rules of conduct and controls in place. Information should be provided to personnel regarding:

- the effects of alcohol and other drugs on health, safety and work performance;
- alcohol and other drugs and its retention in the blood stream;
- the consequences for personnel who fail to comply with the drug and alcohol policy; and
- who to approach for assistance with an alcohol/drug problem.

Port/terminal operators should be equipped with breathalysers and test equipment and regularly organise random screening/testing for alcohol and drugs to detect abuse in due time.

Institutional and Capacity Building

Relevant line agencies should define the maximum permissible blood alcohol content (BAC) to act as a legal reference point to control the use of alcohol. An awareness programme should be developed.

Member countries should establish regulations to measure the BAC of personnel in case of an accident/incident at a port or terminal, similar to the procedure following road accidents.

2.4 RECOMMENDATIONS FOR MITIGATION

The recommendations for mitigation have been divided into the following sections:

1. Emergency and Contingency Planning:
   - Oil Spill Contingency Planning; and
   - Emergency Response Planning.
2. Emergency and Contingency Response System and Equipment:
   - Fixed Fire Water and Foam Systems;
   - Portable and Mobile Firefighting Equipment;
   - Emergency Shutdown Systems; and
   - Oil spill equipment.

2.4.1 Emergency and Contingency Planning

2.4.1.1 Oil Spill Contingency Planning

RECOMMENDATION
Member Countries should determine minimum standards for oil spill contingency plans at ports and terminals, which should be submitted to relevant line agencies where required.

Challenge

Oil spill response plans of some terminals are insufficient. There are currently very limited national or regional spill response plans for the Mekong River and no membership of any large industry-funded Tier 3 response cooperatives.

Oil spills can cause operational disruptions, personal injury and socio-economic and environmental impacts of varying degrees of severity. The consequences of these spills are directly associated with the characteristics and quantities of product involved, with the individual features and sensitivities of the environments affected and/or threatened. Oil released into the environment is exposed to natural weathering, spreading, evaporating, dispersing, sedimentation and emulsification.

I**n addition, the image of companies involved in oil spill incidents is adversely affected. Oil pollution incidents can generate financial losses for publicly-listed companies in addition to fines and cost of emergency response actions.** They can also have legal implications for the polluters, by virtue of the existence of legislation in each country regulating this issue. In the event of an oil spill, the most important factor is time. A rapid and timely action will reduce the extent of a spill and damage to the environment. The faster the response actions can be implemented, the lower the potential damage to the surrounding areas. The speed and the quality of the response depends principally on the degree of preparedness. A well-prepared oil spill response plan is the main key to a successful response.

Under an internationally-adopted system, oil spill incidents are categorised into three tiers. Each tier is defined by the scale of response required and whether it would come from local, regional or national/international resources. Hence the tiers are not related to spill volume as different oils in different locations may require different responses. The categorised tiers are divided as follows:

Tier 1

- **Small operational spills that are within the response capability and resources of an individual port or terminal where the spill occurs.** These spills require immediate response with local personnel and equipment. Spills that impact or threaten to impact within the jurisdiction of an individual country;
- The individual terminal owner/operator or port administrations should develop, implement and maintain the oil spill response plan; and
- Examples: rupture of oil transfer hoses, valve leakage, pump leakage.

Tier 2

- **Medium spills that are within the response capability and resources of the port or local authority where the spill occurs**. These spills cannot be handled by the terminal operator/owner alone. Personnel will be required from other port users or from a local contractor. Spills that impact or threaten to impact within the jurisdiction of an individual country. These spills are covered by National Contingency plan;
- The port authority is responsible for developing, implementing and maintaining an oil spill response plan for the port; and
- Examples: pipeline failure, shipping accidents in port with a limited release.

Tier 3

- **Large spills that are of a magnitude and/or severity that is beyond the response capability and resources of a port where the spill occurs.** National and/or international assistance is required and resources need to be mobilized. Personnel and equipment may be required from an international Tier 3 base. Spill that impact or threaten to impact within the jurisdiction of more than one country;
- A Tier 3 incident is beyond the capability of both local and regional resources. This is an incident that requires national assistance through the implementation of the National Contingency Plan and will be subject to government control; and
- Examples: Tank structure failure, failure of a tankers hull integrity following a total release of cargo and bunkers in port.

For Tier 3 spills, the oil industry has established cooperative response organisations on a regional base throughout the world to provide equipment and specialist manpower to reinforce local capabilities in responding to the largest spills. Examples of these Tier 3 response centres are Oil Spill Response (OSR) and Petroleum Association of Japan (PAJ).

Allocation of an oil spill to a particular tier can only be done when an oil spill actually occurs. The national responsible authority of the country should make an assessment of the spill and determine its tier. Statistics have shown that most spills are Tier 1 spills.

The figure below illustrates that the size of the spill and its proximity to the operations influence the spill category.

Table 1: **Graphic illustration of Tiered response (IPIECA)**

		TIERED RESPONSE		
SIZE OF SPILL	LARGE			TIER THREE
	MEDIUM	TIER TWO	TIER TWO	
	SMALL	TIER ONE	TIER TWO	TIER TWO
		LOCAL	VICINITY	REMOTE
		PROXIMITY TO OPERATIONS		

It is difficult to plan for a spill when the size of the spill is not known. The table below illustrates the quantities which have been used as a rule of thumb for many years to determine the maximum credible spill size[6]:

Table 2: **Average Spill Sizes and Sources**

Source of spill	Maximum Credible Spill Sizes
Tanker	50% of largest vessel
Barge	
Tank Truck	100 % of largest truck
Rail Car	50 % of the rail cars
Pipeline Rupture	6 hours – 25% of maximum flow + drainage
Pipeline Pinhole	2 % of maximum flow for 4 days
Storage Tank Rupture	50 % of largest tank
Material Transfer	50 % of maximum flow for 1 hour
Process Unit	Throughput for 8 hours

References

- *Contingency Planning for Oil Spill, Mr. Brent Pyburn, East Asia Response Pte Ltd (EARL);*
- *Pacific Ocean Pollution Prevention Program, Regional Marine Spill Equipment Strategy (North Pacific Sub-Region);*
- *Pacific Ocean Pollution Prevention Program, Regional Marine Spill Equipment Strategy (South Pacific Sub-Region);*
- *Action against Oil Pollution, International Petroleum Industry Environmental Conservation Association (IPIECA), 2005;*
- *PACPLAN, Pacific Island Regional Marine Spill Contingency Plan (under the auspices of PACPOL – the Pacific Ocean Pollution Prevention Programme);*

[6] http://www.oilspillsolutions.org/planning.htm

- *Planning the Logistics Issues to Enhance Oil Spill Contingency Planning and Response, Sioned Blackburn;*
- *Contingency Planning for Marine Pollution Preparedness and Response, Guidelines for Ports, Maritime and Coastguard Agency (MCA);*
- *International safety guide for Inland Navigation Tank-barges and Terminals (ISGINNT); and*
- *Planning and training for Tier 1 response is fundamental to effective response at all levels, The Global Alliance, Oil spill response Ltd., Richard Santner.*

ACTIONS
Technical and Management

A oil spill contingency planning should comprise of three parts[7]:

Strategy Section:

This section of the plan should address the plan, scope and purpose.

Action Section:

This section of the plan should address emergency call-out procedures and mobilisation of resources. A possible structure for this section.

Data Section:

This section of the plan should contain all maps, lists and data sheets and support information.

Every port/terminal should have an oil spill response plan according the standards required by the competent authority. This response plan should complete, up to date and readily available.

The port/terminaloperator should appoint somebody who will have the responsibility for the plan and to ensure that the information contained in it is kept up to date.

A suitable room should be provided that can be used as emergency control centre in the event of an oil spill. The control centre should be large enough to accommodate the pre-defined emergency response teams and have the necessary resources available to be able to assess and control an oil spill. The control centre should be provided with, but not limited to, the oil spill response plan, facility diagrams, maps of the surrounding area, communication facilities, equipment for recording and displaying the status of the response to the whole team, contact directories, material safety data sheets, dangerous goods register and a list of government agencies to be notified in the event of an oil spill.

Ports and petroleum-handling facility staff that have or are likely to have any involvement in a oil spill incident require training from a provider accredited by the competent authority.

Training and exercise programmes must prepare all facility staff to perform effectively in realistic representations of all the risks that the contingency plan has been designed to meet.

The contingency plan should be exercised once a year. Where possible this should incorporate equipment deployment and incident management, in addition to notifications. Separate notification exercises should be carried out at more regular intervals. This enables contact details to be periodically updated.

Training and exercise records should be kept and updated annually.

[7] Contingency Planning for Marine Pollution Preparedness and response, Guidelines for ports, Maritime and Coastguard Agency (MCA)

Institutional and Capacity Building

Relevant line agencies should adopt a three-tier approach to oil spill contingency planning, preparedness and response with:

- Tier 1: Responsibility of terminal owners/operators;
- Tier 2: Port Authority in cooperation with local authorities; and
- Tier 3: National government and regional cooperation between Member Countries for potential trans-boundary pollution.

Relevant line agencies should determine minimum standards regarding oil spill contingency planning and should prepare a national oil spill contingency plan.

Relevant line agencies should make an inventory of all facilities where the possibility of a Tier-2 (or higher) incidents exists. For these facilities, it should be made compulsory to submit an oil spill response plan to the relevant line agencies.

Member countries should determine incident notification, early warning systems and joint emergency response for spills with the potential for trans-boundary pollution.

2.4.1.2 Emergency Response Planning

RECOMMENDATION

Member Countries should determine minimum standards for emergency response plans which should be submitted to relevant line agencies when there is a possibility of an off-site emergency.

Challenge

Emergency response planning was found to be very limited at some of the ports and terminals in the Member Countries. **Emergency response equipment was to be insufficient or in some cases missing**. Such problems can lead to disastrous consequences in the event of an emergency. Incidents may escalate, exposing surrounding communities to serious risks and causing increased damage to property, the environment and the reputation of the facility involved.

The main objective of an emergency response plan is to protect people, minimise damage to property and the environment and reduce disruption to business operations in the event of an emergency. All ports and terminals should have an emergency response plan ready for immediate implementation in the event of an emergency. In general, the emergency response plan should address:

- all possible types of emergencies that can occur, e.g. major oil spill, toxic gas leak, fire, explosion and human injuries;
- the use of emergency equipment such as firefighting equipment, breathing apparatus, resuscitation equipment, stretchers and means of escape;
- manpower necessary to initiate and sustain the response plan at all times; and
- training and emergency response exercises.

References

- *International Safety Guide for Inland Navigation Tank-Barges and Terminals;*
- *Recommendations on the Emergency Preparedness for Response to and Recovery from Incidents, Buncefield Major Incident Investigation Board, July 2007; and*

- *Dangerous Goods Sites, Emergency Planning Code, Second Edition, Government of Western Australia, Department of Mines and Petroleum, Resource Safety, 2011.*

ACTIONS
Technical and Management

Terminal emergency planning plan components and procedures:

1. Preparation

- The emergency response plan should cover all aspects of the actions to be taken in the event of an emergency. The plan should be developed in close cooperation with the port authority, fire brigade, police and other emergency services; and
- Once formulated, the emergency plan should be properly documented in an emergency procedure manual and be made available to all personnel working at the port or terminal.

2. Control

- The plan should contain a list of the person or persons who have the overall responsibility for dealing with an emergency, listed in order of priority;
- Role and responsibility of all personnel within the terminal to contain and control the emergency; and
- The location of the designated emergency control centre that will be used by key personnel to coordinate the emergency response activities. The control centre should be located at a central point, not adjacent to likely hazardous areas and be fitted with appropriate emergency and communications equipment.

3. Communication and alarms

- The plan must include a description of the alarm system and how it will be operated;
- The emergency plan should include full contact details, both during and outside office hours, for those inside and outside (fire brigade, police and emergency services) the organisation who must be called in case of emergency;
- A reliable communication system is essential for dealing successfully with an emergency situation. A suitable communication system should be provided. linking with all necessary contacts both inside and outside the terminal; and
- The emergency response team should be kept free from communications requirements with other parties not involved in handling the emergency. A dedicated person should be appointed to handle central communications, press and public relations.

4. Site plan and maps:

- Detailed map of the facility and surrounding area; and
- Plans showing firefighting equipment, emergency equipment, major facilities and road access. These should be up to date and readily available.

5. Access to equipment:

- All emergency equipment should be readily accessible and kept free of obstructions at all times.

ACTIONS
Technical and Management (continued)

6. Road traffic movement and control:

- Roadways in the terminal approaches and areas in the way of jetty heads should be kept free of obstructions at all times; and
- During an emergency, traffic into the terminal or onto berth should be strictly restricted to those vehicles and people required to deal with the emergency. Limitations on vehicles weights should be taken into account before emergency vehicles access jetty areas.

7. Outside services:

- The terminal emergency plan should make the best possible use of external services. The success in responding to an emergency may depend on the cooperation received from third parties. This includes:
  - ✓ harbour authorities, Vessel Traffic control Centres, Police and Fire Service;
  - ✓ pilots;
  - ✓ rescue launches; and
  - ✓ medical facilities.

8. Training for emergencies

- All personnel should be trained in the emergency plan and responding to an emergency.

Adequate fire protection and firefighting equipment is to be installed/provided which is designed and constructed for the type and quantity of the dangerous goods and the condition under which they are stored or handled, having regard to:

- the fire load of the goods or liquids;
- other premises/exposures; and
- compatibility with other goods.

On-site fire hydrants and fire-hose coupling points that may be used by the relevant Fire Authority are to be suitable for use by that authority.

All personnel involved must be familiar with the emergency response procedures, should be adequately trained and should clearly understand the action they would be required to take in responding to an emergency. This should include the sounding of alarms, the setting up of a control centre and the organisation of personnel to deal with the emergency.

All personnel should be provided with sufficient training regarding:

- correct use of available firefighting equipment;
- transfer of hazardous materials away from the site of fire;
- fire isolation;
- correct use of Personal Protective Equipment (PPE);
- coordinating operations with outside services;
- rescue, including training for selected personnel in lifesaving from water; and
- spill containment and clean-up.

Technical and Management (continued)

Emergency plans should be tested at least every three years. If not practicable to test all parts of the plan simultaneously, several tests may be conducted during the three-year period and at least one should be a major exercise involving emergency services, adjacent facilities and nearby residents.

Institutional and Capacity Building

- Ports or terminals handling dangerous goods with the possibility of off-site effects of an emergency that may occur at the facility should submit an appropriate emergency plan to the relevant line agencies; and
- Emergency and firefighting equipment requirements should be according should be according the legislation.

2.4.2 Emergency and Contingency Response Equipment/System

2.4.2.1 Fixed Firewater and Foam Systems

RECOMMENDATION
Member Countries should determine minimum standards for fixed fire water and foam systems to ensure they are of sufficient capacity, well maintained and ready for immediate use.

Challenge

Some terminals where dangerous goods are stored or handled have no fixed firewater or foam system savailable or the capacity of the systems is insufficient. Fixed firewater and foam systems are used to protect potentially exposed equipment to avoid fire escalation and to minimise fire damage. In the event of a fire/explosion escalating to a major incident, local communities, the environment and property are at risk.

References

- *International Safety Guide for Inland Navigation Tank-Barges and Terminals (ISGINNT);*
- *NFPA 30, Flammable and Combustible Liquids Code;*
- *NFPA, Fire Pump Handbook; and*
- *Handbook of Fire and Explosions Protection Engineering Principles for Oil, Gas, Chemical and Related Facilities, Noyes Publications, Dennis P. Nolan, P.E., 1996.*

ACTIONS
Technical and Management

Terminal personnel should be able to fully operate the fixed firefighting systems within the first 5 minutes following the outbreak of a fire. These systems depend on:

- type and quantity of the fixed-fire fighting system;
- terminal size and location;
- size and quantity of the vessels/barges berthed per year;
- quantities of cargo handled; and
- physical layout of the terminal.

ACTIONS
Technical and Management (continued)

There are too many variables that have to be taken into account to make specific recommendations concerning fixed-fire and foam systems. However, there should be consideration of:

- the storage capacity of firewater which should be at least the amount of water necessary for four hours continuous use at maximum capacity of the firefighting system; and
- firewater flow rates and pressure which should be sufficient to cover cooling and extinguishing requirements for a fire that might realistically occur.

Fire pumps should be located in a safe and protected location to ensure that they stay operational during a fire. The fire main piping should be provided with isolating valves to prevent loss of the firefighting system due to a single damage or blockage of the fire main network. Fire hydrants should be readily accessible and located or protected in a way that they will not be subject to physical damage.

An international shore connection should be available to connect the terminal fire water system to the ships fire main in case of emergency.

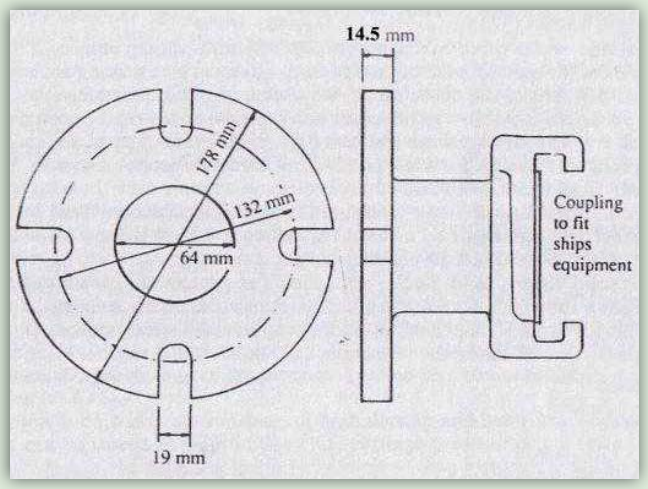
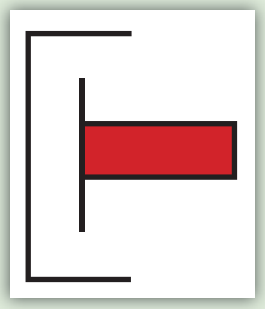


Figure 12: **International Shore Connection**[8]

Foam concentrate should be properly portioned and mixed with water downstream from the fir water pump and upstream from foam-making equipment and application nozzles.

Fixed fire and foam systems should be regularly inspected and tested to ensure reliable operation and be part of a planned maintenance system to ensure they are in a constant state of readiness.



Institutional and Capacity Building

All personnel should be trained in the operation and use of the fixed-fire and foam systems.

[8] http://www.marineinsight.com/misc/marine-safety/what-is-international-shore-connection/

2.4.2.2 Portable and Mobile Firefighting Equipment

RECOMMENDATION
Member Countries should determine minimum standards for portable and mobile firefighting equipment to ensure these are ready for immediate use, well maintained and regularly inspected by external authorities where necessary.

Challenge

A lot of hazards concerning portable firefighting equipment were nominated as being in the high-priority area. Deficiencies included firefighting equipment not being available, readily accessible, maintained and regularly inspected. Others included equipment being in a bad state or not having equipment available. These deficiencies should be rectified with high priority.

Portable firefighting equipment is used to attack a fire in its initial stages and prevent it from spreading so it is of utmost importance that the equipment is carefully selected and suitable for the risks involved. Fire extinguishers should be located, identified and protected so they are clearly visible, unobstructed and readily available at any moment.

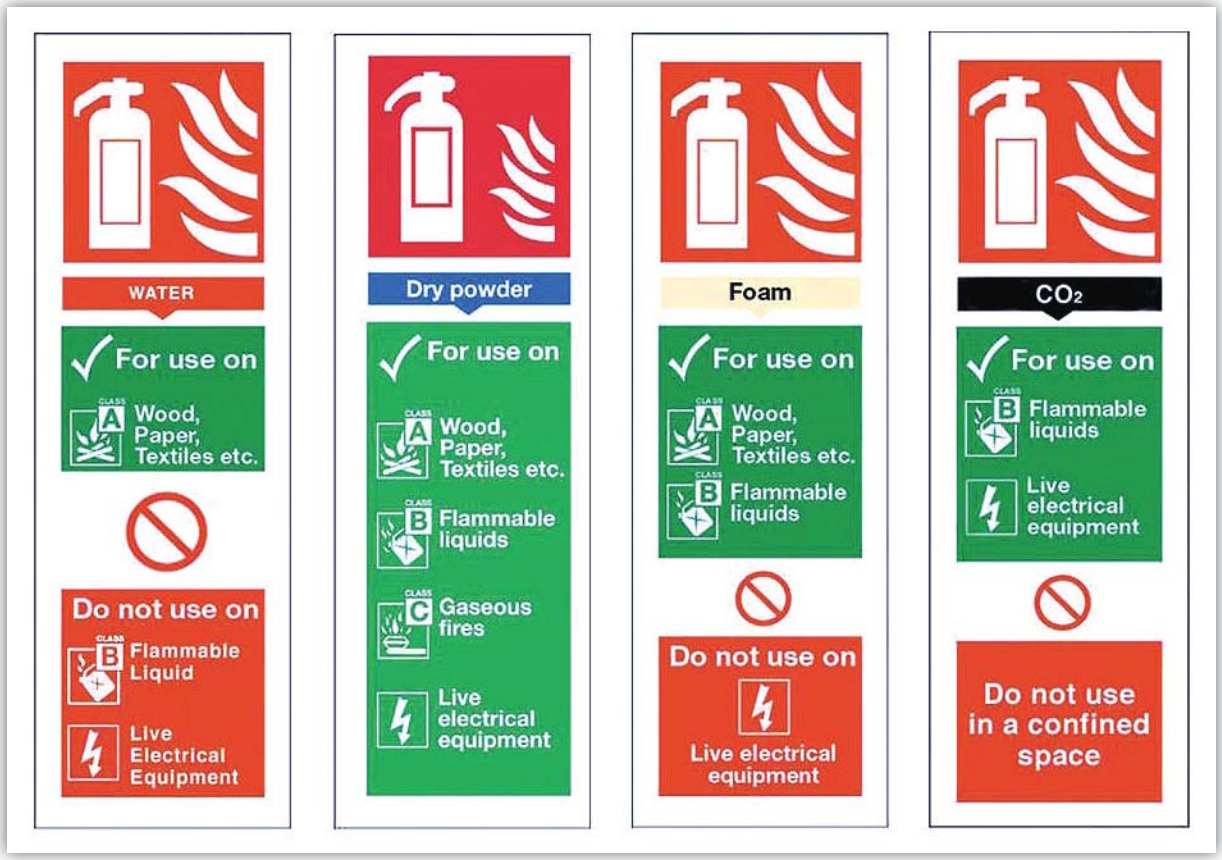


Figure 13: **Fire Extinguishers and Symbols**[9]

[9] http://www.spservices.co.uk/item/Brand_FireExtinguisherSign-Water-Adhesive_7_0_2397_0.html

References

- *British Standard Code of Practice BS 5306-3;*
- *Guidelines on Maintenance and Inspection of Fire Protection Systems and Appliances (MSC/Circ.850, 8 June 1998);*
- *International Safety Guide for Inland Navigation Tank-Barges and Terminals (ISGINNT); and*
- *Guidelines – Safe Storage of Dangerous Goods and Dangerous Substances, Thai-German Dangerous Goods Project, November 2002.*

ACTIONS
Technical and Management

The following portable and wheeled fire extinguishers should be provided at every terminal berth, wharf jetty or fuel-transfer location handling flammable liquids including flammable liquids in drums:

- Site handling less than one tanker per week:
  - 2 x 9 kg portable dry chemical extinguisher
  - 2 x 50 kg wheeled dry chemical extinguisher
- Sites handling more than one tanker per week:
  - 4 x 9 kg portable dry chemical extinguisher
  - 2 x 75 kg wheeled dry chemical extinguisher

Fire extinguishers should be located at the berth so that they can be reached without travelling more than 15 m. Location of fire extinguisher should be clearly marked by luminous background paint (glows in the dark in the event of a power cut) or suitable coloured protective boxes. The lifting handle should be at a height of less than one metre. (see figure 6 below)

Figure 14: **Luminescent Sign for Dry Powder Extinguisher**

ACTIONS
Technical and Management (continued)

Fire Extinguisher Chart

Extinguisher		Type of Fire				
Colour	Type	Solids (wood, paper, cloth, etc)	Flammable Liquids	Flammable Gasses	Electrical Equipment	Cooking Oils & Fats
	Water	✓ Yes	✗ No	✗ No	✗ No	✗ No
	Foam	✓ Yes	✓ Yes	✗ No	✗ No	✓ Yes
	Dry Powder	✓ Yes	✓ Yes	✓ Yes	✓ Yes	✗ No
	Carbon Dioxide (CO2)	✗ No	✓ Yes	✗ No	✓ Yes	✓ Yes

Figure 15: **Fire Extinguisher Chart**[10]

In general, port or terminal operators should make sure that all portable firefighting equipment is:

- located in a readily-accessible position;
- identified to be clearly visible;
- well protected against physical damage (e.g. vehicle impact);
- unobstructed and readily available;
- not adversely affected by hazardous or climatic conditions; and
- regularly inspected, serviced, pressure tested and recharged as necessary (see instructions from supplier or manufacturer).

Terminal or port operators should provide portable fire-extinguishing equipment in the right number, appropriate kind and with the proper capacity.

[10] http://www.allfireextinguishertypes.com/fire-extinguisher-types/

ACTIONS
Technical and Management (continued)

Companies should develop procedures for responsible people to ensure that a visual inspection is carried out on all fire extinguishers on the premises at least monthly. These inspections should be documented and records kept in the fire safety manual. The visual inspection should cover at least, but not be limited to:

- checks that the extinguisher is in its correct location;
- checks that the anti-tamper seal is not missing;
- if stored pressure, visual checks of the pressure gauge;
- checks for any damage to the extinguisher;
- confirming the operating instructions are legible; and
- ensuring the extinguisher(s) are unobstructed and visible.

Port/terminal personnel should be trained in and practice the use of firefighting equipment in accordance with the requirements of the relevant line agencies.

Institutional and Capacity Building

- Relevant line agencies should determine minimum standards for portable firefighting equipment. These should be verified on regular basis by a competent inspector.
- Relevant line agencies should determine minimum requirements for port/terminal personnel regarding training in and practising the use of firefighting equipment.
- Relevant line agencies should set standards for companies authorised to service firefighting equipment.

2.4.2.3 Emergency Shutdown Systems

RECOMMENDATION
Member Countries should determine minimum standards for emergency shutdown systems and port and terminal operators should ensure procedures are implemented to test the system prior to commencing cargo transfer operations.

Challenge

In some ports and terminals where fuel is transferred, there is no emergency shutdown system available.

An Emergency Shut Down System (ESD) is designed to minimise the consequences of emergency situations, related to typically uncontrolled flooding, escape of hydrocarbons, or outbreak of fire in hydrocarbon-carrying areas or areas which may otherwise be hazardous.

References

International Safety Guide for Inland Navigation Tank-Barges and Terminals

ACTIONS
Technical and Management

Every fuel transfer site should have emergency means to shutdown and stop the flow of cargo transfer operations from the terminal to the tank vessel or barge.

A point in the cargo-transfer system, at which the emergency means stop the flow of petroleum products on the terminal, shall be located near the dock/jetty manifold connection to minimise the loss of cargo transferred in the event of rupture or failure of the fuel transfer hose, loading arm, manifold valve or in case of tank overfilling. Both the terminal personnel (during discharging from the vessel) and crewmembers (during loading of the ship) in charge of cargo transfer operations should be able to order or activate the emergency shutdown system. The means of emergency shutdown initiated by terminal or vessel personnel shall be either:

- an electrical, pneumatic or mechanical linkage to the terminal; and
- a voice communications system continuously operated by a person on the terminal who, at all times during the cargo transfer operations, can hear the communications and can, at any time, activate the emergency shutdown.

If the ESD is activated and automatic valves are fitted, the cargo transfer rate should be adjusted to avoid pressure surges evolving from the automatic closure of any such valves. This is to avoid exceeding the safe working pressure of either the vessel or shore pipeline system.

Procedures developed for initiating an emergency shutdown should be communicated and recorded between ship/barge personnel and terminal personnel in charge of cargo-transfer operations.

Emergency shutdown systems and procedures should be tested before commencement of cargo-transfer operations to ensure they are fully understood by both the tanker and terminal personnel.

Institutional and Capacity Building

Relevant line agencies should make an emergency shutdown system compulsory for all oil terminals located on waterways and verify the presence of the system.

2.4.2.4 Oil Spill Equipment

RECOMMENDATION
Member Countries should make an inventory of all ports and terminals where there is potential for Tier 2 (medium) oil spills and ensure there is adequate response equipment available. Port and terminal operators should ensure that sufficient oil spill equipment is provided, ready for immediate use and well maintained.

Challenge

Some terminals do not have sufficient oil spill equipment available and/or the equipment is either not properly maintained or readily accessible. The National Working Groups determined that there is a big difference in available equipment between terminals in the same region.

Effective oil spill preparedness and response can only be possible if enough oil spill equipment is readily available and all personnel involved are sufficiently trained in the correct use of the equipment. Under an internationally adopted system, oil spill incidents are categorised into three tiers. Each tier is defined by the scale of response that is required and whether it would come from local, regional or national/international resources (see recommendation on oil spill response):

Tier 1

- **The terminal owner/operator is responsible** for the response including the stockpiling of Tier 1 oil spill equipment.

Tier 2:

- **The national government is responsible** for the response including the stockpiling of Tier 2 oil spill equipment.

Tier 3:

- **No individual country has the capability of responding** to a Tier 3 spill including the maintenance of Tier 3 oil spill equipment. International cooperation between governments and industry is necessary for stockpiling of Tier 3 oil spill equipment.

All countries involved have differences in operation, risks and potential effects. Each country has unique circumstances as to location and availability to outside support (Tier 2 and Tier 3). Although each port/terminal should be assessed individually (oil type, size of operations, environment and isolation form Tier 3 response providers), there are no standard requirements stating the equipment necessary to respond to the different tiers of oil spill incidents.

References

- *Pacific Ocean Pollution Prevention Program, Regional Marine Spill Equipment Strategy (North Pacific Sub-Region)*[11]*;*
- *Pacific Ocean Pollution Prevention Program, Regional Marine Spill Equipment Strategy (South Pacific Sub-Region)*[12]*;*
- *Action Against Oil Pollution, International Petroleum Industry Environmental Conservation Association (IPIECA), 2005; and*
- *PACPLAN, Pacific Island Regional Marine Spill Contingency Plan (under the auspices of PACPOL – Pacific Ocean Pollution Prevention Programme).*

ACTIONS
Technical and Management

Each terminal/port should be assessed individually to determine the exact needs for oil spill equipment. Equipment performance specifications to be determined prior to any equipment being purchased.When determining the performance specifications, consideration should be given to compatibility of new equipment with existing resources and those of Tier 3 support providers.

A maintenance schedule to be developed for the oil spill response equipment based around three-monthly and 12-monthly intervals. By each interval, a task list should be drafted formulating the inspection and maintenance procedures to be carried out. These task lists are on the type of equipment, how regularly it is used and where it is stored.

[11] http://www.sprep.org/solid_waste/documents/Binder1-NorthSouthReport.pdf

[12] http://www.sprep.org/solid_waste/documents/Binder1-NorthSouthReport.pdf

ACTIONS
Technical and Management (continued)

The storage of the oil spill equipment should be in close proximity to likely spill sites and take into consideration being:

- secure against unauthorised entry;
- clean, dry and well ventilated;
- pest free;
- protected from direct sun light;
- readily accessible; and
- separated from flammable, explosive or dangerous goods.

In most cases, the equipment will need to be transported from the storage location to the spill site. In this case, the necessary transport infrastructure has to be considered.

All terminals and facilities with the possibility of a Tier 2 (or higher) incident should make a complete inventory of all available oil spill response equipment. This inventory should be submitted to the relevant line agencies.

Equipment manuals obtained from the supplier at the time of purchase should be kept at the premises and be readily available.

Maintenance schedule should be developed for all oil spill response equipment. This schedule should be documented and readily accessible.

Institutional and Capacity Building

Relevant line agencies should determine minimum requirements regarding training and practice in the use of pollution-combating equipment.

A programme should be developed, both locally and nationally, to ensure training takes place at regular intervals. This should include industry, port authority and government personnel to ensure continued familiarity with equipment and to strengthen working relationships.

National line agencies should ensure that the minimum level of training includes:

- an initial equipment familiarisation sessions;
- equipment operating principals and techniques and equipment deployment; and
- advanced training to ensure that operators' level of knowledge is maintained and enhanced.

(The International Maritime Organization (IMO) has developed a model training course addressing equipment operation and deployment.)

Relevant line agencies should make an inventory throughout the region of available oil spill equipment.

Relevant line agencies should determine minimum oil spill equipment stockpile requirements.

Relevant line agencies should determine all terminals/facilities where a Tier 2 (or higher) incident is possible. It should be compulsory for these ports/terminals to submit a complete inventory of available spill response equipment. The collected data should be stored and readily available at the national emergency control centre.

Institutional and Capacity Building (continued)

Relevant line agencies should determine if there is a lack of oil spill equipment both at a national and regional level and determine the necessary oil spill equipment requirements.

Relevant line agencies of the different countries should develop a joint strategy on the minimal oil spill equipment requirements to ensure that equipment is available at both the national and regional levels. This strategy should include recommendations on:

- type and quantity of equipment;
- where it is to be located; and
- the logistics of access to these equipment stockpiles on both national and regional level.

3. VESSELS

3.1 INTRODUCTION

There is a clear need for heightened awareness and better real-time information about the full array of activities involving the transport of dangerous goods in the Member Countries to ensure the safety and security of people and operations and the environmental protection of the Mekong River. Proper management of vessel operations not only requires strict policies by the ship owners or charterers but also much more advanced monitoring and control by the relevant authorities. Many studies show human error as the cause of about 80 percent of all maritime casualties. Hence, protecting the environment and enhancing safety require continued focus and vigilance not only by the industries but also by the authorities concerned. Moreover, improving commercial vessel safety, security, and environmental protection should be a regional concern as there is potential for pollution incidents and navigational accidents to become a trans-boundary problem.

Vessel owners, operators and government agencies responsible for controlling and implementing safety procedures and equipment share responsibility for continued improvement in vessel safety, security, and environmental compliance. Improvements should be based on a combination of voluntary and regulatory measures, including a broad range of guidelines and mandatory legal regimes for domestic and international transport of dangerous goods. In the short to medium term, attention has to be focused on the implementation, control, and enforcement of appropriate and harmonised technical standards and management requirements on the Mekong River. The success of these efforts will depend on a broad domestic and international framework with several components. A strong voluntary commitment on the part of the vessel owners and operators to build a culture that incorporates safety, security, and environmental protection is crucial. Upholding high values for efficient and safe vessel operations is a key factor. Another very important component is a regional and international commitment to effective control and enforcement, both by those with primary responsibility for vessel operation and by receiving ports.

The process of building a *culture of safety* requires a strong commitment within the industry. Safety and environmental plans should be effectively incorporated into routine vessel operations, including investments in improved workplace safety and training. Reliable means of measuring the success of these initiatives, as reflected in crew and company performance, are paramount and should be accompanied by third-party audits and compliance monitoring by relevant authorities in the Member Countries. Performance-based inspections, focussing on demonstrations of crew competencies and incorporation of vessel-safety management plans into daily operations, provide the best means of evaluating the effectiveness of implementation efforts.

The MRC provides the forum for developing, adopting, reviewing and updating the regulatory framework in which navigation on the Mekong River operates. With the adoption and implementation of regulations on the carriage of dangerous goods on the Mekong River, the safety and security record as well as the environmental performance of the inland tank-barge industry in Member Countries will improve. However, improvement cannot be brought by regulation alone. It depends also on good practices adopted and constantly refined by the industry, and a dedication to safety and environmental protection by the people it employs.

3.2 PREPARATION OF THE RECOMMENDATIONS

The purpose of the recommendations is to improve safety of transport of dangerous goods at the interface of inland tank-barges with other vessels or shore facilities (terminals and ports) and, in doing so, reduce the risk of pollution and protect the environment. Recommendations are based on best-known practices on the operation of tank-barges and risk-based control. By enhancing risk awareness, the recommendations will try to make an environment where deficiencies and uncertainties associated with some shipboard operations are reduced with prescription. They will also encourage barge crew and their employers to identify - on a regular basis - the risks in every shipboard action and then implement risk-reduction measures. This puts the focus on people and is, therefore, entirely consistent with a strategy related to the human element.

The recommendations are made for personnel on the safe carriage and handling of such products that are normally carried in petroleum and chemical inland tank-barges as well barges carrying packaged dangerous goods either in containers or as general cargo. They will provide operational advice to assist personnel directly involved in tanker operations and when handling dangerous goods in general.

Guidance on and examples of certain critical aspects of tankers and barges carrying dangerous goods are provided and show how these aspects have to be managed. The recommendations formulated have primarily the intention of dealing with existing hazards onboard an inland waterway barge that form a risk of fire, explosion and pollution. It therefore deals with the precautions to be taken to mitigate the most critical hazards onboard. In this chapter, recommendations are made based on the Risk Analysis (Volume 1) conducted by the National Working Groups. International experts have compared the findings with best practices and recommendations follow priorities in the Risk Analysis.

In Volume I, priority areas were assigned to different vessel types wereapplicable:

- Cambodia Cargo Vessel;
- Viet Nam Tanker - High-Standard;
- Viet Nam Tanker - Low-Standard;
- China Tanker; and
- Lao PDR Cargo Vessel.

Priority levels are based on the minimum requirements. Some countries may already apply above or beyond certain standards that are recommended in Volume II.

Recommendations for prevention are made for both tanker barges carrying dangerous goods in bulk and barges carrying packaged dangerous goods. Problems are identified from the risk analysis or industry standards, with references and the main causes of major incidents in the inland waterborne transport and maritime industry.

The basis for the recommendations originates from the results of the Risk Analysis, and the identification of the priority areas. Priority areas for vessels differ from country to country, and even within one country where "low-standard" and "high-standard" vessels have been used as referencea. As the idea is to reach common standards in the future, the recommendations have take into account practical and feasible solutions to improve the transport of dangerous goods. The results give a very reasonable reflection of the current situation vis-à-vis what should be there. It may be that some fleet owners already apply or go beyond some of the recommended standards and guidance. The recommendations are very important to reduce the risks of fire, explosion or pollution and to increase the safety of crews and protect the environment.

Although most of the recommendations apply to all barges carrying dangerous goods, some recommendations apply specifically to tanker barges and some to barges carrying dangerous goods as general cargo or in containers.

For each recommendation a target group is mentioned, being the group of barges to which it applies. The following target groups are considered:

- **all barges** including barges carrying dangerous goods, ferries and passenger vessels;
- **tanker barges** or barges equipped with tanks that may carry dangerous goods in bulk such as petroleum products and chemicals; and
- **cargo barges** or barges built to carry solid dangerous goods in bulk or packaged dangerous goods either as general cargo or in containers.

3.3 RECOMMENDATIONS FOR PREVENTION

The recommendations for prevention are divided in the following sections:

- Design, Construction and Equipment;
- Operations and Procedures;
- Management;
- Human Elements; and
- Documentation.

3.3.1 Design, Construction and Equipment

3.3.1.1 Vessel Design and Construction

Target group: All barges

RECOMMENDATION
Member countries should establish standards for the design and construction of vessels and verify that these standards are complied with.

Challenge

Tankers must satisfy a substantial number of design requirements when built for safety and pollution-prevention purposes. Ten basic characteristics must be considered when constructing a barge:

1. dimension;
2. hull form;
3. machinery size;
4. speed and endurance;
5. cargo capacity and deadweight;
6. accommodation arrangements;
7. cargo/ballast tank arrangements;
8. subdivision and stability accommodations;
9. relative amounts of steel; and
10. basic scantling and structural arrangement.

The size of a vessel chosen for a particular trade route depends on:

1. the length of the voyage;
2. the type of cargo;
3. the storage capacity at the receiving end; and
4. physical port restrictions, e.g. available water depth, at the ports visited.

There are many guidelines to study for the best design, and they are applied in many parts of the world. In many cases, vessel construction is based on previous experiences or on what other shipping fleets have to model from. The worst-case scenario is when there are no existing national or regional standards for cross-border and international transport.

For vessel design and construction, it is necessary to consider past shipping accidents including direct and root causes. In the case of Mekong River, there is limited or no accident data available that might relate casualties or pollution to the cause of the accident in relation to the vessel's structure. There is also no accident information available that allows for detailed analysis of how the vessel's structure, compartment arrangements, ventilation and safety systems may have contributed to major incidents including fatalities, pollution and commercial loss. Hence, there are no studies that have been conducted to demonstrate how a vessel's construction has contributed to accidents and how the incident could have been prevented.

Wherever tank barges travel, the threat of pollution exists. The type and condition of tank barges sailing on the Mekong River varies considerably. Moreover, traffic on the Mekong River is increasing. The absence of proper standards or failing to monitor and control the implementation of technical standards contributes further to risks and compromises safety.

Numerous tanker barges, including an important number visited by the National Working Groups, were found to be in very poor condition . The need to improve safety for the crew and means for preventing pollution is critical to prevent major incidents.

References

- *ADN (European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways) Chapter 9;*
- *Legislation 2006/137/EC ;*
- *Directive of the European Parliament and of the Council of 18 December 2006 amending Directive 2006/87/EC laying down technical requirements for inland waterway vessels; and*
- *Port State Control (PSC).*

RECOMMENDATIONS
Technical and Management

Design requirements must be formulated and put in place based on a proper balance of three main categories:

1. Adopt existing international legal requirements such as *ADN Legislation 2006/137/EC: Directive of the European Parliament and of the Council of 18 December 2006 amending Directive 2006/87/EC- laying down technical requirements for inland waterway vessels.*
2. Existing national laws, technical standards (as in Viet Nam) and classification society requirements.
3. Best practice to ensure that all Member Countries adopt the same technical requirements considering that cross-border and international navigation is already underway.

It is important to distinguish that the balance should take a reasonable and feasible approach into account. Member Countries are not required to implement technical standards in a short time with limited technical capacity, budget and resources. For example, the implementation of *ADN Code* in Europe was a phased approach so level and cost transition should be applied. Pushing through very sudden and strict reforms could mean that the industry will either not be able or will choose not to adopt the technical standards.

Certain adjustments, such as fitting a bulwark or fence, a spill belt or a slop tank, do not have to be very expensive and can be dealt with quite easily. There is, however, a need for certain changes among the highest priority areas which may be more difficult or expensive to follow. On the other hand, the transport of petroleum products is a lucrative business and some companies can afford to allocate higher budgets to pollution and accident prevention measures which could also help to reduce insurance premiums. The companies also have a moral responsibility to protect the safety of their employees and the environment.

Tanker barges should be constructed in accordance with the rules of a classification society that are essentially concerned with the structural integrity of the vessel and its propulsion and steering systems. To maintain their classification, the barges must be presented for survey (especially hull and machinery) at regular intervals.

Owners and operators should be aware that they have to invest in the short term to improve elementary standards of the existing barges, especially items such as slop tanks, spill belts, drip trays and navigation equipment to make navigation and cargo operations safer and prevent pollution. New buildings should comply with construction requirements according to regulations.

Institutional and Capacity Building

It is crucial that authorities are responsible for regulations and enforcement related to standards for vessel design, construction and safety of life and protection of the environment. Some of these tasks can be fulfilled by the classification society.

The Member Countries can adopt a practice of "port state control"[13] for inland vessels on the Mekong River to guard against hazards posed by unsafe vessels. So authorities of the Member Countries can inspect foreign-flagged vessels entering local ports to ensure compliance with national regulations or agreed standards for safety and structural conditions.

Penalties for non-compliance or violations must be agreed upon jointly but established by the flag state. Penalties can include removal of the current certificate, detaining the vessel, indictment, warning, fine or imprisonment of the responsible person.

Authorities should provide training to make a team of nautical inspectors who will need to check if barges comply with the regulations (like Port State Control for seagoing ships).

3.3.1.2 Navigation Equipment

Target group: All barges

RECOMMENDATION
Member countries should establish minimum safety requirements for navigation equipment including VHF, GPS, foghorn and electronic charts.

Challenge

There are no minimum safety requirements for navigation equipment onboard barges and night navigation on the Mekong River is hazardous. On the upper stretches, it should not be allowed because of the many rocky outcrops and difficult navigation. In Cambodia and Viet Nam, it should be allowed but due care need to be taken as many small vessels do not carry navigation lights. During the wet season, monsoon rains can be very heavy, blurring all visibility. One of the most important tools to assist is the radar, used to measure the bearing and distance of vessels to prevent collisions with other vessels and to navigate and fix their position on the river by using fixed references such as islands and buoys. In port or in Vessel Traffic Systems (VTS), radar systems are used to monitor and regulate vessel movements in busy waters. GPS apparatus will also provides barges with their exact location on the river or waterway in combination with correct navigation charts which will also make navigation safer.

Monitoring locations and routes of vessels should be done in the future, especially for laden tankers. If there is an oil spill, it should be known from where the spill originates. A useful tool used by the ship and VTS is the Automatic Identification System (AIS), an automated tracking system for identifying and locating vessels by electronically exchanging data with other nearby vessels and VTS stations. The information provided by AIS equipment (unique identification, position, course and speed) can be displayed on a screen or on an electronic chart (ECDIS). In navigation, AIS is primarily used to avoid

[13] In 1978, a number of European countries agreed in The Hague on a memorandum that agreed to audit whether the labour conditions onboard vessels were according to the rules of the ILO. After the Amoco Cadiz sank that year, it was decided to also audit safety and pollution. To this end, the Paris Memorandum of Understanding (Paris MoU) was agreed upon in 1982, establishing Port State Control which now covers 26 European countries and Canada. In practice, this was a reaction to the failure of the flag states - especially flags of convenience that have delegated their task to classification societies - to comply with their inspection duties. Port State Control (PSC) is the inspection of foreign (maritime) ships in other national ports by PSC officers (inspectors) for the purpose of verifying that the competency of the master and officers onboard, that the condition of a vessel and its equipment comply with the requirements of international conventions (e.g. SOLAS, MARPOL, STCW, etc.) and that the vessel is manned and operated in compliance with applicable international law.

collisions. If a VTS system is in place in busy river sections and ports, the information provided by AIS can be used to manage vessel traffic as it gives information about identification and movements. The MRC developed a strategy for the use of AIS, which called for implementing AIS coverage along the Mekong River between Phnom Pehn and the Viet Nam border and future installations of AIS equipment at other strategic locations along the Mekong River. Presently about 21 barges, mainly containerships, sailing between Phnom Pehn and Viet Nam are equipped with AIS transponders.

Other important navigation tools are a good working fog-horn (or bad-visibility horn) to warn other traffic in reduced visibility and to give different sound signals and an echo-sounder to indicate keel clearance. Suitable (at least the minimum) navigation equipment onboard, combined with good waterway infrastructure, allows navigation to be conducted in a safe and more efficient manner. On the Mekong River in Cambodia and Viet Nam, tanker barges operating in dense traffic are currently not equipped with navigation tools that are accepted worldwide as necessary to conduct safe navigation.

Although successful efforts have been made in marking the main channels of the Mekong River with buoys, the waterway infrastructure is far from sufficient to give essential nautical information to the waterway user. To support inland waterborne transport in difficult situations or when a casualties occur, a VTS system could be of great importance. However, this involves the presence of VHF equipment on onboard as well as ashore. Another problem with cross-border and international navigation in the Lower Mekong Basin is the different languages used.

References

- *Legislation 2006/137/EC : Directive of the European Parliament and of the Council of 18 December 2006 amending Directive 2006/87/EC laying down technical requirements for inland waterway vessels;*
- IMO MSC.1/Circ.1216;
- ISGINTT 4; and
- MRC Cambodia: AIS Sites inspection Report and Supply and Installation of an AIS.

RECOMMENDATIONS
Technical and Management

Necessary navigation equipment to be installed on board at the first stage, especially for tanker barges:

- radar;
- echo-sounder;
- foghorn (bad visibility horn); and
- VHF.

Necessary navigation equipment to be installed on board at the second stage, especially for tanker barges:

- GPS; and
- AIS apparatus.

VTS system set up, or if existing to be extended to involve inland waterway traffic. This includes the general use of VHF equipment.

The owner or operator should provide the necessary equipment to make navigation safer and make sure all crew assigned for watch keeping are familiar with the operation of these equipment.

ACTIONS
Institutional and Capacity Building

Vessel Traffic Service should be organised by authorities.

Regulations should be implemented concerning minimum level of navigation apparatus onboard inland waterway barges, especially tanker barges.

Controls should be made on the availability and working condition of navigational equipment and the presence of correct navigation charts. All vessels and tanker barges should be certified and recorded.

Training should be provided for personnel manning the VTS platform, for all designated government personnel involved in checking barges, on how to use the most important navigation equipment. Crews should be trained on the use of all navigation equipment (especially radar-certified) and be tested in Maritime/Inland Transport Institutions.

3.3.1.3 Propulsion Equipment and Maintenance

Target group: All barges

RECOMMENDATIONS
Member countries should establish minimum technical standards for propulsion equipment and implement intermediate surveys to ensure maintenance and safe operation.

Challenge

A ship owner always needs to ensure that the ship is properly maintained and operated so that it remains in conformance with all applicable national, regional (and international) standards and requirements. Most lapses and deficiencies onboard can be prevented by doing regular operational checks, maintenance and repairs of machinery and equipment. This includes maintaining shipboard records properly and confirming the validity of all certificates and documents as well as verifying the survey dates of all relevant class and statutory surveys.

Always taking care to keep things in good order on a vessel and striving to improve the shipboard environment can go a long way to enhancing safety in daily operations. Propulsion equipment is all equipment used for the propulsion of the vessel: the main engine, the steering gear and generators. This equipment should be maintained and operated well for safe operation of the vessel. On the Mekong River, this is often not the case. Accidents can easily occur when there is a blackout of the main engine or steering gear failure.

Correct engine maintenance is important to ensure efficient operation of a main engine and its auxiliary systems (generator) to avoid breakdowns and to increase the lifespan of systems. A reliable engine is necessary for safe navigation and to reduce the risks of collision and grounding. Moreover, engine rooms are hot, noisy, sometimes dirty, and potentially dangerous. The presence of flammable fuel, high-voltage electrical equipment and internal combustion engines means that a serious fire hazard exists in the engine room, which should be monitored continuously by the crew and monitoring systems. A well-maintained engine room reduces the risk of fire and personal accidents. Efficient planning, recording and adequate usage of equipment is the key to productive maintenance.

A recent safety-alert bulletin by Exxon Mobil regarding main engine control failures highlights the importance of a well-maintained engine[14]. The information herein provided deals with seagoing vessels. However, it is assumed that these results are similar for inland waterway barges. In its evaluation of all incidents with seagoing vessels between 2008 and 2010, the safety-alert bulletin found that the most

[14] Safety Alert Bulletin, Exxon Mobil, International Marine Transportation Limited: "Main Engine Control Failures")

important cause was "main engine failure" (followed by "deck spills" and "miscellaneous machinery failure"). This highlights the importance of encouraging an internal review of the main engine control system (remote and emergency) operations as well as inspections and maintenance procedures to minimise such failures. In case of main engine failure, only the rapid restoration of propulsion control will ensure the safety of the vessel, crew and the environment.

Main engine control failure can be prevented by improved inspection regimes, reduced maintenance intervals and increased management focus on maintenance. The use of emergency control systems for quick restoration of propulsion capability can mitigate the risk of remote-control failure. Emergency manoeuvring should be provided to sustain or restore normal operation of propulsion machinery in the event of remote-control failure. As failure of other machinery is the third important cause of incidents, efficient and regular maintenance is very important.

References

- *Classification Society; and*
- *Legislation 2006/137/EC: Directive of the European Parliament and of the Council of 18 December 2006 amending Directive 2006/87/EC laying down technical requirements for inland waterway vessels.*

ACTIONS

Technical and Management

There are different types of maintenance procedures. An efficient system, however, is a Preventive or Scheduled Maintenance System, where maintenance is carried out as per running hours or by calendar intervals irrespective of the condition of the machinery. Parts have to be replaced if noted in the schedule, even if they can still be used. Also, daily controls have to be carried out to ensure the good working of the engines and to prevent leaks. This includes the main engine and all other machinery onboard such as steering gear and generators.

An emergency control system for quick restoration of propulsion capability should be in place and used to mitigate the risks associated with main engine failure.

Maintenance planning procedures (and recording) should be in place.

Daily checks and routine maintenance should be carried out by using a control checklist.

Contingency plans and actions that address the failure of the remote engine control system and an emergency action plan for steering in case of steering gear failure should be in place with training.

Institutional and Capacity Building

Authorities should provide theoretical and practical education for crewmembers assigned as engineers onboard. After an examination, a certificate to prove competence should be issued.

Existing tanker barges should have their propulsion equipment, including propeller and rudder, checked and certified by an independent company at regular intervals to ensure reliability and proper maintenance by the ship's crew and owner. Execution of this task on behalf of authorities can be done by classification societies with specific and intermediate surveys at regular and fixed intervals.

Propulsion equipment should be designed for the specific operation, the size and trade of the barge. Technical standards should be put in place by authorities and controlled by classification societies for new buildings.

Personnel should be trained for effective maintenance, making sure engines, instruments and systems work safely and efficiently. Detailed technical knowledge of naval construction and mechanical, electrical and electronic engineering systems is needed.

3.3.1.4 Cargo Handling Equipment

Target group: Tanker barges

RECOMMENDATION
Member countries should establish minimum technical standards for cargo-handling equipment including cargo pipes, hoses and valves.

Challenge

There is no system in place for inspecting and maintaining the cargo pump in the pump room and the cargo pump on the deck. There is no evidence of a preventive maintenance schedule onboard the vessel for this equipment. There are also no procedures or checklists available to crewmembers that can be completed prior to commencing loading/discharging operation. Maintenance and operational procedures are considered a high priority. Failure to maintain cargo pump and associated equipment will increase the risks of an incident occurring.

Under cargo handling equipment, the following important items are considered:

- pump room;
- cargo pump;
- cargo hoses and pipes,
- cargo valves;
- drip trays;
- spill belt;
- tank-measurement device and tank-capacity alarm;
- emergency shutdown system; and
- gas detection.

This equipment requires close attention as the proper and adequate use greatly reduces the risk of fire, explosion and pollution.

Pump Room and Cargo Pumps

A pump room has a large concentration of cargo pipelines and connections between pipes and cargo valves and is the place where leaks are likely to occur. It has the potential to be a highly dangerous place onboard that should be monitored closely. Leakage of a volatile product from any part of the system could lead to rapid generation of a flammable or toxic atmosphere. It contains a number of potential ignition sources which are only under control if structured maintenance, inspection and monitoring procedures are followed. Because of their location, design and the operational need to be routinely entered by personnel, pump rooms are spaces that present a particular hazard and necessitate special precautions to prevent fire, explosion and fatal injuries. Cargo pumps in pum prooms and on deck should be checked for leaks prior to any cargo operation to avoid fire or explosion and pollution.

Cargo Hoses and Pipes

The cargo and bunker hoses, pipelines and manifolds of barges are often in poor condition, not properly rigged and not appropriate for the service intended. This condition can easily cause important and repeating spills with high risk of fire or explosion and pollution.

Drip Trays

Suitable drip trays should be placed under each manifold to collect any spillage occurring during connecting or disconnecting.

Spill Belt

Most of the tanker barges are not provided with a spill belt, used to collect spillages from a tank overflow or any other spillage during cargo or bunker operation to prevent the spill from entering in the river. It is normally designed to collect liquid cargo of up to 200L.

Tank Measurement and Tank-Capacity Alarm

The tanker barges sailing on the Mekong River are not fitted with any tank-measurement device or tank-capacity alarm. This increases the risk of an overfill and tank overflow which can result in extensive pollution and, depending on the kind of cargo, high risk of fire or explosion.

Emergency Shutdown System

An emergency shutdown procedure, and alarm, should be agreed between the tanker and the terminal and recorded on an appropriate form. The agreement should designate those circumstances in which operations must be stopped immediately. Due regard should be given to the possible dangers of a pressure surge associated with any emergency shutdown procedure.

Gas Measuring Instruments

Benzene, toluene and xylene (aromatic hydrocarbons) are components in many petroleum cargoes. The supplier should advise the tanker about these components in the cargo to be loaded. Regular exposure to concentrations of benzene vapours (even very low) will undoubtedly cause cancer.

H2S (hydrogen sulfide) can be encountered in many crude oils, and refined products such as naphtha, fuel oil, bunker fuels, bitumens and gas oils. H2S is a very toxic, corrosive and flammable gas. The gas is colourless, heavier than air and soluble in water. It is often commonly referred to as "rotten egg" gas.

The safe management of operations onboard tankers is often dependent upon the crew's ability to determine the composition of the ambient atmosphere (or in an enclosed space). Tanker crew needs to measure the oxygen, flammable and toxic gas concentrations in an atmosphere. This will enable them to detect the presence of explosive mixtures, toxic vapours or oxygen deficiency that may present a risk of explosion or hazard to personnel. However, gas-measuring instruments are not provided onboard tanker barges that have been checked.

- *Classification societies;*
- *AND; and*
- *ISGINTT.*

ACTIONS
Technical and Management

Pump Room

Ventilation: the use of mechanical ventilation by extraction is required to maintain the atmosphere in a safe condition.

Gas detection system: should be provided to indicate the presence of explosive gases or lack of oxygen. An audible and visual alarm should be installed.

Pump room entry procedures: should be in place to control pump room entry. Notices should be displayed at the entrance, prohibiting entrance without permission, and after checking the oxygen level.

Cargo Pipes and Hoses

Cargo pipes and valves must be constructed following prescribed technical standards (steel thickness, welding, pipe support) and regularly checked for corrosion or rust spots. They should be regularly pressure tested (MAWP).

All piping such as cargo pipes, freshwater pipes, ventilation lines and steam lines should be marked following a colour code to avoid error or confusion. For the same, raison valves should be properly labelled.

Hoses should be in good condition and properly fitted and rigged to prevent strain and stress beyond design limitations.

Unused cargo and bunker line connections should be closed and blanked. Blanked flanges should be fully bolted.

Hoses and pipelines have to be built from a material suitable for the substance handled, including its temperature and the maximum operating pressure.

Cargo hoses should be clearly marked to allow identification of the products for which they are suitabler, maximum working pressure specified, test pressure and last date of (yearly) testing, and maximum and minimum service temperature.

Spill Belt and Drip Tray

Spill belts should be constructed on every tanker barge. This is a very useful and simple part of the vessel's construction, and a very cost-effective method to prevent pollution of he waterways. Scuppers should be properly plugged during cargo operations and accumulations of water should be drained off periodically.

The contents of drip trays, portable or fixed under each manifold connection, should be emptied in slop tanks after cargo operations.

Tank Capacity Measurement

Tank-measurement devices and overfill alarms (audible and visual) should be installed for each cargo tank, tested each time before cargo operations and marked in the safety checklist.

ACTIONS
Technical and Management (continued)

Emergency Shut Down System

Easy to install and effective in use are the emergency shutdown push buttons on various places on deck, enabling the crew to shut down the cargo pumps from different places in case of an emergency.

Gas Measuring Instruments

These instruments, together with detailed instructions for their use, should be provided onboard, especially on tanker barges. These instruments should be calibrated on a regular basis and provided with a certificate to confirm that calibration has been carried out.

Institutional and Capacity Building

Technical standards for cargo systems and pump rooms should be adopted, implemented, certified and checked at prescribed intervals. This task can be executed by the classification societies on behalf of the authorities and incorporated in the prescribed survey.

Training (theoretical and practical) should be provided on handling dangerous goods and tanker cargo operations, and should be examined and certified. Refresher courses should also be provided.

3.3.1.5 Electrical and Communication Equipment

Target group: Tanker barges

RECOMMENDATION
Member countries should ensure that electrical equipment is regularly inspected and well maintained.

Challenge

Electrical equipment is often not in good condition and there are no procedures onboard to ensure maintenance and safe operation. When handling dangerous cargoes, flammable gases are to be expected in cargo compartments, pump rooms, deck workshops, store rooms and sometimes the tank deck. Strict elimination of all possible sources of ignition (such as sparks) is essential. Other areas, like the accommodation, inevitably contain ignition sources such as electrical equipment, matches, and cigarette lighters where it is essential to avoid the entry of flammable gas.

I**n a tanker, certain areas/spaces are defined by international convention, flag administrations, legislation and classification societies as being dangerous/hazardous for the installation or use of electrical equipment either at all times or during specific periods such as loading, ballasting, tank cleaning or gas-freeing operations.** Definitions of dangerous areas on tankers, detailed in the classification society rules, are derived from recommendations by the International Electrotechnical Commission (IEC) as to the types of electrical equipment that can be installed. All apparatus, systems and installations, including cables, conduits and similar equipment, should be maintained in good condition. To this end, they should be inspected regularly.

All equipment, systems and installations should be inspected when first installed. Following any repair, adjustment or modification, those parts of the installation that have been disturbed should be checked in accordance with national requirements. The integrity of the protection afforded by the design of explosion-proof or intrinsically-safe electrical equipment may be compromised by incorrect maintenance procedures. Even the simplest repair and maintenance operations must be carried out in

strict compliance with the manufacturer's instructions and national requirements in order to ensure that such equipment remains in a safe condition. This is particularly relevant in the case of explosion-proof lights where incorrect closing after changing a light bulb could compromise the integrity of the light.

To assist with routine servicing and repair, tankers should be provided with detailed maintenance procedures and/or manuals for the specific systems and arrangements fitted onboard.

Insulation testing should be carried out on a regular basis (every three years) to ensure all equipment is properly insulated and grounded. The test should be confirmed by a certificate. This should only be done when no flammable gas mixture is present.

References

1. *ISGINTT 4 & 8;*
2. *Classification societies;*
3. *Legislation 2006/137/EC: Directive of the European Parliament and of the Council of 18 December 2006 amending Directive 2006/87/EC laying down technical requirements for inland waterway vessels; and*
4. *IEC 60092-502 Electrical Installations in Ships – Part 502:Tankers.*

ACTIONS
Technical and Management

All electrical equipment must be regularly inspected and well maintained. Only electrical equipment approved by the classification society may be installed in the dangerous area.

Naked lights must be prohibited on deck and other places where flammable gas could be present. All portable equipment such as but not limited to torches, cameras, radios, calculators, laptops, mobile phones of non-approved typed must not be active, switched on or used within hazardous areas.

All portable equipment used on deck must be of a safe type, approved by a competent authority, because of the possibility of spark formation.

All other electrical (fixed) equipment such as deck lights and cargo pumps, should be earthed. On-board barges, the connection is made to the main metallic structure of the vessel, which is earthed because of the conductivity of the river.

All external doors, portholes and windows in the accommodation, stores and machinery spaces should be closed during cargo operations to prevent the entry of gases. This requirement does not prevent reasonable access to these spaces, but doors should not be left open unattended. Engine room vents may be left open.

Prior to any cargo operation, a safety checklist should be used to eliminate and potential ignition sources.

Safety instructions should be implemented and displayed onboard for all crewmembers in order to manage the risk of fire and explosion due to ignition sources.

Institutional and Capacity Building

Safety regulations should be implemented and controlled by the authorities.

Vessel construction should be monitored by authorities or a classification society to ensure compliance with safety regulations.

Training on handling dangerous cargoes should give special attention to making the crew aware of the risk of fire and explosion due to ignition sources in hazardous areas.

3.3.2 Operations and Procedures

3.3.2.1 Safe Working Procedures (SWP)

Target group: All barges

RECOMMENDATION
Member countries should ensure that vessel operators develop safe working procedures for critical operations onboard.

Challenge

Safe working procedures (SWP) have not been developed for critical operations onboard vessels. Most of the barges carrying dangerous goods do not use such procedures for the various operations and activities that have to be carried out onboard. Safe working procedures are very important for loading/discharging, bunkering, tank cleaning, mooring, entering enclosed spaces and executing hot work. If safe working procedures are not in place, not used or not followed, the consequences might be the use of wrong PPE, wrong sequencing of activities, wrong or no action, underestimation, wrong or no emergency procedures and response, and an increased risk of personal injuries, property damage, pollution and fire or explosion depending on the kind of activity or operation that has to be carried out.

References

- *Maritime and Coastguard Agency (Executive Agency of the Department for Transport UK): Code of Safe Working Practices for Merchant Seamen*

ACTIONS
Technical and Management

Safe working procedures should be adopted for all important activities and operations that have to be carried out onboard. Information should be readily available and fully understood by all crew-members.

The operator of the barge should implement the use of safe working procedures onboard for all main activities and operations to ensure the safest possible execution of different tasks.

Institutional and Capacity Building

The authorities could implement the use of safe working procedures as part of a Safety Management System.

The crew should be aware of the importance of using Safe Working Procedures and should be trained onboard.

3.3.2.2 Safety Checklists

Target group: All barges

RECOMMENDATION
Member countries should ensure that vessel operators develop safety checklists for critical operations onboard including navigation tools, loading/discharging, cargo transfer, bunkering and safety items.

Challenge

Safety checklists for critical operations are not available onboard vessels in Member Countries. The safe conduct of operations while a tanker is at a terminal is the responsibility of the tanker's master and the terminal representative. Before operations start, the two parties should agree in writing on the transfer procedures including maximum loading or discharging rates, on action to be taken in the event of an emergency and complete and sign the appropriate safety checklist.

A checklist is a list of items that have to be verified, checked or inspected before an action or operation is carried out. It contains a detailed number of pre-determined questions and tick-boxes to be completed. The main purpose is to reduce the chance of critical items being forgotten.

Safety checklists are used at some terminals but are non-existent at others. Port regulations should include and oblige the use of an approved checklist and effective use should be verified by port authorities. The safety checklist is one of the most important documents when it comes to conducting safe cargo or bunkering operations as all critical items are verified and agreed between barge and shore or terminal before starting any operation.

Transfering dangerous or noxious substances between an inland waterway tanker barge and a terminal should be prohibited unless all parts of the vessel/terminal safety checklist have been completed in full and truthfully, and signed by the persons responsible from the terminal and the tanker involved. This should take place before the transfer, either in the terminal or onboard the tanker barge involved. In such situations, the terminal and tanker barge involved must comply with the terms of the safety checklist during the transfer of a dangerous or noxious substance and for as long as the tanker barge involved is moored at that spot. The transfer of a dangerous or noxious substance must be halted immediately if the terms of the safety checklist are not complied with.

References

- *ISGINTT 26,*
- *Port of Rotterdam: Port Regulations on Dangerous Substances 2007 Appendix II*.

ACTIONS
Technical and Management

Safety checklists should cover:

- loading/discharging;
- cargo transfer;
- bunkering;
- watch keeping;
- navigation tools;
- survival equipment;

ACTIONS
Technical and Management (continued)

- condition of life and firefighting equipment; and
- tank cleaning.

Cargo operation procedures and bunkering procedures should include the use of the safety checklist prior to any operation.

Institutional and Capacity Building

Port regulations should include and implement the use of an approved safety checklist for tanker barges and terminals for every cargo or bunkering operation.

Training should be conducted on the use of the safety checklist. This involves knowledge of the hazards of dangerous goods and how to conduct cargo operations in a safe way. Practically, this refers to filling in the safety checklist which should be verified only by an educated and experienced crewmember who takes responsibility when signing for approval.

3.3.2.3 Precautions During Cargo Handling

Target group: Tanker barges

RECOMMENDATIONS
Member countries should establish minimum safety requirements for cargo handling and bunkering operations.

Challenge

Few vessels take adequate precautions prior to loading and discharging cargo. A number of precautions must be observed by tanker and terminal/shore when handling cargo, ballasting, bunkering, tank cleaning and gas freeing are being carried out in port. The risk of fire and explosion should be eliminated at all cost. Most important are hazards associated with naked lights, smoking, galleys, electrical equipment, external openings in accommodation and the engine room, pump room, air conditioning and ventilation systems as well as openings in cargo tanks, inspections of cargo tanks, tanker and shore cargo connections, product spillage and leakage and proximity to other vessels.

Spillage of product should be avoided at all costs to prevent pollution and fire and explosion due to ignition. A report by ExxonMobil affiliate International Marine Transportation Ltd showed that deck spills were the second most important cause of incidents onboard seagoing vessels between 2008 and 2010 and it might be assumed that the situation is similar for inland waterway barges.

According to International Tanker Owners Pollution Federation Ltd, most spills are the result of a combination of actions and circumstances, all of which contribute in varying degrees to the final outcome. The following analysis explores the incidence of spills of different sizes in terms of the primary event or operation in progress at the time of the spill. These "causes" have been grouped into "Operations" and "Accidents". Spills for which the relevant information is not available or where the cause was not one of those given are listed under "Other/unknown".

It is apparent from the table that:

- most spills from tankers result from routine operations such as loading, discharging and bunkering which normally occur at ports or terminals;
- the majority of these operational spills are small, with some 91 percent involving quantities of less than 7 tonnes; and

- accidental causes, such as collisions and groundings, generally give rise to much larger spills, with at least 84 percent of incidents involving quantities in excess of 700 tonnes being attributed to such factors.

Table 3: **Incidence of Spills by Cause (1970-2010)**

Operations	< 7 tonnes	7–700 tonnes	> 700 tonnes	Total
Loading/Discharging	3,157	385	37	**3579**
Bunkering	562	33	1	**596**
Other Operations	1,250	61	15	**1,326**
Accidents	**< 7 tonnes**	**7–700 tonnes**	**> 700 tonnes**	**Total**
Collisions	180	337	132	**649**
Groundings	237	269	160	**666**
Hull Failures	198	57	55	**310**
Fire & Explosions	84	33	34	**151**
Equipment Failures	202	39	4	**245**
Other/Unknown	1,975	121	22	**2,118**
TOTAL	**7,845**	**1,335**	**460**	**9,640**

Source: ITOPF Oil Tanker Spill Statistics 2010

References

- *ISGINTT 4 and 24; and*
- *International Chamber of Shipping 1992: Safety in Oil Tankers.*

ACTIONS
Technical and Management

A number of predetermined precautions must be observed by tanker and terminal/shore when cargo handling, ballasting, bunkering, tank cleaning and gas freeing are carried out in port. These include:

- prohibiting naked lights on the tank deck and other places where there is a risk of flammable gas being present;
- smoking restrictions;
- restrictions on using appliances that employ naked flames while a tanker is at the terminal;
- restrictions on using navigational equipment on the bridge;
- closing all external doors, ports and other openings of the accommodation and engine room during cargo operations. Volatile cargo vapours should be kept out of these spaces; and
- on tankers with air conditioning units, keeping the accommodation under positive pressure to prevent entry of cargo vapours. Intakes for these units should be positioned in a safe area so that vapours are not drawn into the accommodation. On tankers depending on natural ventilation, care should be taken on the position of the inlets as no vapours may enter the accommodation. Otherwise they should be covered or closed.

In general, all openings of cargo tanks that are not gas free, such as cargo tank lids and ullage ports, should be kept closed.

Tanker and shore personnel should maintain a close watch for possible leakage of cargo at the commencement of and during cargo transfer operations. All pipeline valves not in use should be closed.

ACTIONS
Technical and Management (continued)

Any spillage on deck should be immediately removed, and the oil spill should be reported to the terminal and port authorities with shore and tanker oil pollution plans should be activated.

In case a spill belt is in place, the scuppers must be effectively plugged to prevent spilled cargo escaping into the water.

When a tanker is alongside a berth, firefighting equipment is to be ready for immediate use. This means that firehoses with spray/jet nozzles are ready for use, and portable dry-chemical powder extinguishers are available in the cargo area that can be used as protection against small flash fires.

Shipping company management has to encourage the use of safe working procedures and checklists as a practical result of a safety management system. The means should be made available to handle cargo in the safest possible way.

Institutional and Capacity Building

Port authorities should implement comprehensive and clear safety measures for barges carrying dangerous goods and during cargo operations. Execution of these safety measures should be regularly controlled by maritime police onboard. Cargo operations should be suspended and the barge fined if port safety regulations are not strictly followed.

Training courses in dangerous goods handling should provide crewmembers with the necessary theoretical knowledge and safe working practices. Skill and experience have to be learnt onboard, when working under the supervision of an experienced crewmember.

A tanker barge should display notices on deck, visible on two sides:

Figure 16: **Notices on a Tanker Barge (ISGINTT 24)**

3.3.2.4 Hot Work

Target group: Tanker barges

RECOMMENDATION
Member countries should ensure that safety measures are implemented and a competent authority is informed prior to carrying out hot work operations in port.

Challenge

Hot work refers to operations where heat and/or sparks may be produced and is not limited to welding and gas-cutting operations. It also includes operations such as grinding and abrasive cutting. Hot work presents two specific hazards:

- open flames or flying sparks that are able to ignite any flammable gases (most important hazard); and
- the hot work itself may produce toxic fumes and gases.

There have been a number of fires and explosions due to hot work in, on, or near cargo tanks or other spaces that contain, or have previously contained, flammable substances or substances that emit flammable vapours. Hot work should therefore be performed only under strict controls and these should be incorporated in hot work procedures. Controls can include the completion of a Hot Work Permit and associated risk controls. Precautions before executing any hot work are extensive and depend on the area or place where the hot work is planned.

References

- *ISGINTT 4;*
- *ISGINTT 9; and*
- *Australian Marine Safety Agency Marine Notice 20/2010.*

ACTIONS
Technical and Management

Before any hot work is executed, it is necessary to identify and, where needed, to remove flammable or explosive, vapours, liquids and materials in the vicinity of the work and related adjacent spaces. This includes flammable vapours and liquids that may be in pipework or containers (such as drums).

It might be necessary to isolate and protect plant equipment in the area that may be affected by hot work and give rise to additional risks.

The atmosphere should be tested in the vicinity of hot work or related adjacent spaces for the presence of gases, flammable gases and vapours.

The appropriate clothing, PPE, suitable tools, equipment and materials should be used.

Firefighting equipment should be provided in the vicinity of the work and in related adjacent spaces.

Masters and operators of ships should have an effective hot work procedure in place and ensure that it is complied with including the use of a Hot Work Permit.

Institutional and Capacity Building

When a vessel is in port, there may be a requirement to inform the port authority where and when the hot work is carried out.

The ship's crew should be made aware of the dangers when executing hot work. This should be incorporated in courses on handling dangerous goods.

Hot work should be only undertaken by people who have had relevant training and who are deemed competent for undertaking hot work.

3.3.2.5 Enclosed/Confined Spaces

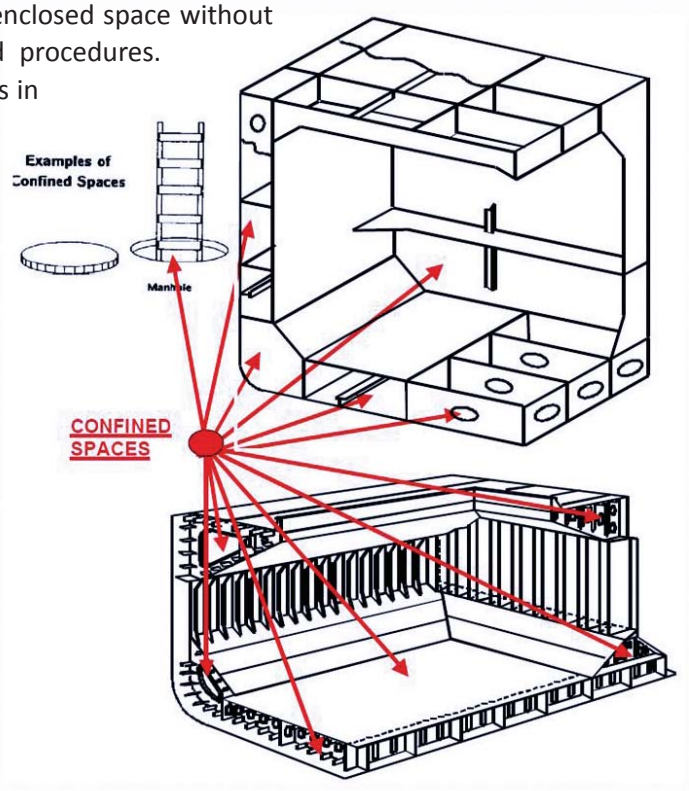
Target group: All barges

RECOMMENDATION
Member countries should ensure that safety measures are implemented onboard prior to entering enclosed/confined spaces.

Challenge

Enclosed or confined spaces are considered a very high priority area. An enclosed or confined space is every space onboard that allows entry and exit via limited openings, has limited or no ventilation means and is not designed for worker occupancy. Enclosed spaces are normally closed completely and only entered to carry out repairs such as leaks or maintenance tasks. Examples of enclosed spaces are cargo tanks, double-bottom tanks, void spaces, cofferdams, ballast tanks and fuel tanks.

Important hazards for crewmembers when entering an enclosed space can be oxygen deficiency, presence of flammable or explosive vapours and toxic vapours. Confined spaces may be subject to leakage from the adjacent space. Such leakage often remains undetected because the space is not subject to regular gas measurements and ventilation. Work in an enclosed space often causes fatalities, severe injuries and illness as people enter an enclosed space without proper supervision and adherence to agreed procedures. Attempts by crewmembers to rescue colleagues in difficulty in an enclosed space often results in additional casualties.



Source: IACS Rec.No.72

References

- *ISGINTT 10; and*
- *IACS Rec. No.72 (International Association of Classification Societies Ltd.)*

ACTIONS
Technical and Management

The enclosed space should be well in advance and continuously ventilated to ensure a safe atmosphere. Instruments to check the oxygen level and presence of flammable or toxic gases must be available depending on conditions.

PPE should be available. As each confined space will present different hazards and degrees of risk to health and safety, the final provision of PPE should be based on an assessment of risk.

A SWP should be in place, including a checklist for evaluation if the enclosed space is safe to enter, as well as permits-to-work and permits-to-enter.

Rescuers must be trained in emergency procedures and follow established emergency procedures. They must use appropriate equipment and techniques (such as lifelines, breathing apparatus, stand by people). Emergency and evacuation procedures should be agreed upon and understood by all parties involved in a potential rescue operation. Steps for safe rescue should be included in all confined space entry procedures. Rescue should be well planned and recorded drills conducted.

Institutional and Capacity Building

The ship's crew should be made aware of the possible hazards involved when entering an enclosed space.

3.3.2.6 Permit to Work

Target group: All barges

RECOMMENDATION
Member countries should ensure that a permit to work (PTW) system is established onboard vessels for critical operations.

Challenge

To manage hazardous tasks, a Permit to Work system can be used. This is a formal written system used to control specific types of work such as hot work or work in enclosed spaces and tank inspections. The Permit to Work includes a number of documents to control hazardous activities such as a work instruction, maintenance procedure, operational procedure, a checklist and a permit. The Permit to Work form is designed to lead the operator through an appropriate process in a logical, detailed and responsible manner. The permit should ensure that all safety concerns are fully addressed.

References

- *ISGINTT 9; and*
- *Navis.gr Occupational Safety - Permit to Work system.*

Technical and Management

The Permit to Work should be prepared for all hazardous tasks or operations onboard and should be readily available for the assigned responsible crewmember.

The companies should develop their own procedures for managing all aspects of operations and tasks undertaken. The Permit to Work system can be incorporated in order to manage hazardous tasks.

Institutional and Capacity Building

PHEMSEA offers training on implementing the Code

3.3.2.7 Bunkering Operations

Target group: All barges

RECOMMENDATION
Member countries should ensure that safe work procedures and an approved safety checklist are developed for bunkering and cargo operations.

Challenge

A number of vessels do not have safe working procedures or checklists for bunkering operations. Spillages and leakages during bunkering operations are a primary source of oil pollution. Experience has shown that many bunker overflows and spillages are the result of human error. Personnel involved in bunkering operations should have no other task and should remain at their workstations during topping-off. Spillages often occur when crewmembers are distracted by another task.

References

- *ISGINTT 25;*
- *Helcom Recommendation 24/6; and*
- *Steamship Mutual: May 2008 Oil Spills During Routine Bunkering Operations*

ACTIONS
Technical and Management

Clear procedures on bunkering operations are required. The procedures need to be followed before during and after bunkering operations. These procedures include the strict use of an approved checklist.

All bunkering operations should be controlled under procedures incorporated in the companies' Safety Management System. These procedures ensure that the risks have been assessed, and that controls are in place to mitigate these risks, including contingency arrangements in the event of a spill. After considering all items for the procedures, it should be implemented by use of a checklist (ISGINTT Appendix 5: Bunkering Safety Check-List for Bunker Delivery to Inland Ships).

Institutional and Capacity Building

Port authorities should implement the normal, essential safety measures for cargo operations where dangerous goods are involved.

Crew responsible for bunkering should be properly trained and be fully aware of all risks involved. Special attention should be paid to the fact that continuous monitoring during bunkering is necessary to prevent spills and overflows.

3.3.3 Management

3.3.3.1 Waste Management

Target group: All barges

RECOMMENDATION
Member countries should develop a waste management system for handling waste from vessels.

Challenge

The purpose of waste-management plans for ship-generated waste and reception facilities is to reduce and eliminate illegal dumping of wastes into the river and so prevent pollution. Unsatisfactory waste handling and/or illegal dumping takes place due to inefficient or no waste-management operations and a lack of control and recovery systems.

Ship-generated waste means bilge water, domestic and operational waste and cargo-associated waste. The development and implementation of waste-management plans in ports presents the most effective means of minimising and avoiding the potential consequences of operational and illegal discharge of oil and garbage from ships on the aquatic environment. A port waste-management plan should describe the waste streams and handling routines and provide clear instructions for port users.

Waste-reception facilities in Member Countries are limited. These facilities

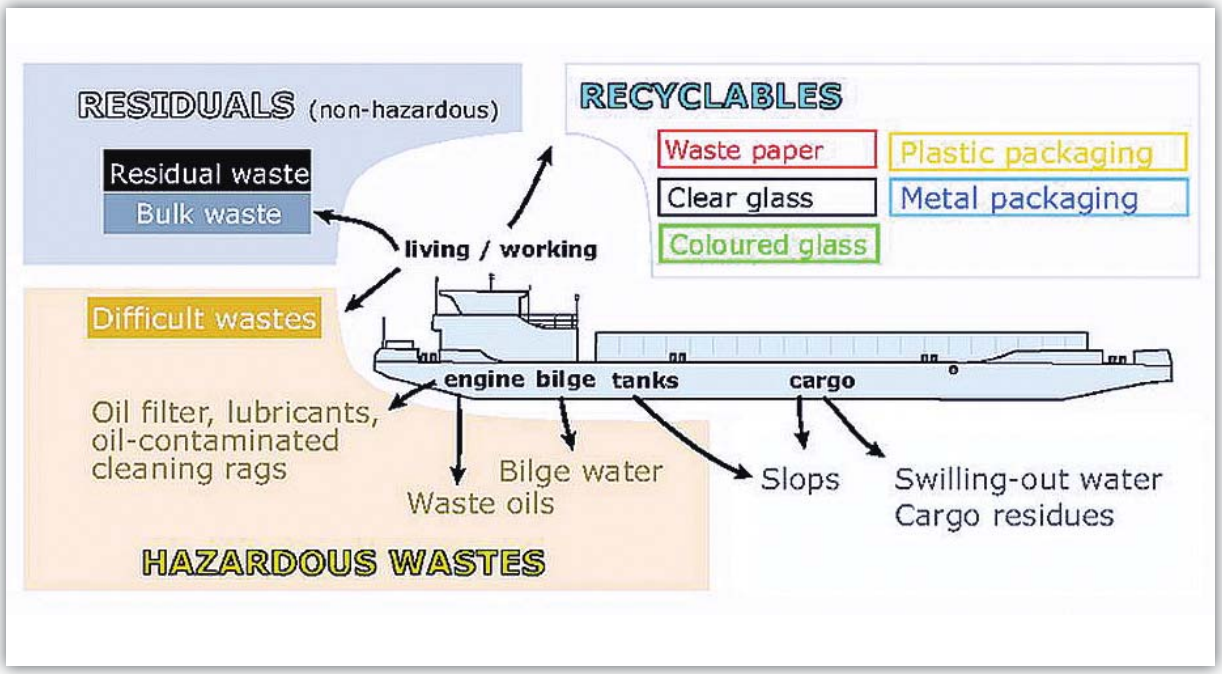


Figure 16: **Wastes Generated Onboard Cargo Vessel (Source: INE WANDA)**

should be standard, operational and readily accessible. The cost of disposing bilge water and other wastes ashore should be low as additional costs that are too expensive for the shipowner or operator will result in illegal disposal. Records should be made in an oil record book and eventually a cargo record book (in case of cargo residues) that can be inspected by the designated authority.

Special attention is needed for oily bilge water from vessels and cargo residues from tankers which on the Mekong River mostly carry petroleum products. Oil is the most studied form of pollution from shipping and is estimated to contribute for about 45 percent of the total petroleum input into the marine environment. (EMARC Project, Research and Development VII-E, WA-95-SC-097 Page 29).

On a ship, oil often leaks from engine and machinery spaces or from engine maintenance activities and mixes with water in the bilge, the lowest part of the hull of the ship. Oil, gasoline, and byproducts from the biological breakdown of petroleum products can harm fish and wildlife and pose threats to human health if ingested. Even in minute concentrations, oil can kill fish or have various sub-lethal chronic effects.

Bilge water also may contain solid wastes and pollutants containing high amounts of oxygen-demanding material, oil and other chemicals. For instance, a typical large cruise ship will generate an average of eight tonnes of oily bilge water for each 24 hours of operation. Different sources estimate that about two percent of daily heavy fuel oil (HFO) consumption and about 0.5 percent of the daily marine diesel oil (MDO) consumption remains as sludge[16]. To maintain ship stability and eliminate potentially hazardous conditions from oil vapors in these areas, the bilge spaces need to be flushed and periodically pumped dry. Bilge water should be pumped over to reception facilities or bilge barges, designed for collecting bilge water. Along the Mekong River, however, untreated oily bilge water is mostly discharged directly into the river, where it can damage aquatic life.

Figure 17: **Waste Reception Facility on Danube River**

Bilge water pumped overboard is a very important and serious form of continual pollution taking into consideration the number of barges sailing and therefore needs special attention. Inland Navigation Europe reported in June 2011 that a mobile bilge-water collection vessel had started on the Danube River in Austria and Hungary. The vessel collects free of charge bilge water as well as oily rags, filters, bins and other ship waste and domestic waste generated onboard. Water is separated from the bilge onboard and thrown back into the river while the used oil is stored in cisterns and delivered to waste-disposal facilities onshore.

References

- *Waste production of MARPOL Annex V, ship-generated;*
- *INE (Inland Navigation Europe);*
- *Waste Management for Inland Navigation on the Danube, Recommendations on Harmonized Europe-Wide; and*
- *Technical Requirements for Inland Navigation Vessels Resolution No. 61 United Nations.*

[16] Waste Management Planning for Ship Generated Waste, Journal of Naval Science and Engineering, Volume 1, Number 2, July, 151-159, 2003.

RECOMMENDATION
Technical and Management

Ship-generated waste including bilge water and domestic, operational and cargo-associated waste should be collected onboard. This requires specific technical standards regarding construction including the need to have, for example, appropriate slop tanks and bilge pumps.

Waste must be delivered ashore at regular intervals.

A waste management plan should be made by the ship's operator for inland waterway barges to deal with all waste generated onboard. This plan can be used only in combination with an effective Port Waste Management Plan in use, and controlled by port authorities.

Institutional and Capacity Building

Port authorities should have an effective Port Waste-Management Plan. Such plans should refer to legal and organisational aspects, effective ship waste-handling procedures, responsibilities, cost-recovery systems, waste-registration procedures, communications, control and enforcement, ownership of reception facilities, technical installations and a maintenance plan.

Crewmembers should be made aware of the consequences of waste disposal in the river and the dangers of pollution for the environment. Crew should be trained in dealing with different kinds of waste generated onboard and the use of the ship's waste management plan.

3.3.3.2 Safety Management

Target group: All barges

RECOMMENDATION
Member countries should develop inspection procedures to verify the implementation of safety and environmental protection measures onboard vessels.

Challenge

Management of safety includes a lot of activities and operations that have either a high or very high priority area. All participants in the carriage of dangerous goods should take appropriate measures according to the nature and the extent of foreseeable dangers to avoid damage or injury and, if necessary, to minimise their effects. To control health and safety aspects associated with the handling of dangerous goods, it is recommended that a safety management system is in place aimed at minimising related risks.

For safety management in transporting dangerous goods by inland waterways, the International Safety Management (ISM) Code for seagoing vessels may be used as an example should there be no equivalent Code addressing inland waterborne transport. All seagoing tankers, as defined in the SOLAS and MARPOL Conventions, are required to comply with the ISM Code if they are of 500 gross tonnage and over. The ISM Code provides an international standard for the safe management and operation of tankers and for pollution prevention. The Code requires that tanker operators should:

- provide for safe practices in tanker operation and a safe working environment.
- establish safeguards against all identified risks.
- continually improve the safety management skills of personnel ashore and aboard tankers, including preparing for emergencies related to safety and environmental protection.

To deliver the required levels of safety, the Safety Management System will need to address all activities undertaken in the operation of the tanker together with possible situations that may arise which would affect the safety of the tanker or its operation. The end result should be a safe system for work. ISM is not an obligation for inland waterway barges. If the owner or operator of the barge wants to comply with the ISO 9001 requirements in European countries, however, they need a quality system. Part of the requirements of the quality system is making up an instruction manual that deals with procedures and instructions for good management of the barge and that should carefully be followed by all crewmembers under supervision of the captain.

The oil, petrochemical and chemical industries use tank barges for the transport of products along canals, rivers and estuaries. In general, these barges are not owned by the companies themselves but by independent owners/operators which range in size from a few owning large fleets down to individuals who own (and frequently master) a single barge.

In Europe, oil companies want to assure themselves that the barge being hired is fit for purpose, conforms to all legislative requirements and is operated in a safe manner to ensure protection of the environment and safety of both the crew and the general public. Representatives of the most important oil companies have made up a questionnaire, a checklist to check the general condition of the tanker barge and the competence of the crew. Known as the European Barge Inspection Scheme (EBIS), the questionnaire is extensive and includes items such as barge certificates and statutory records, barge manning certificates, training, health and safety, drug and alcohol policy, firefighting and lifesaving equipment, environmental protection, cargo transfer operation, wheelhouse and navigation, mooring, engine room, operational safety, barge appearance and cargo measurement and cargo custody. In this way, barge owners and operators are forced to have a safety management system and keep the barge in good working condition. If tanker barges do not comply with this checklist on one or more items, they are not allowed at the terminal of the oil company that participates with EBIS until the item is resolved. The questionnaire is filled in by an authorised inspector on regular bases. The interval of these inspections depends on the age of the barge (for barges older than 20 years, it is every 6 months).

References

- *ISGINTT 9;*
- *IMO Resolution A.741 (18); and*
- *EBIS.*

Technical and Management

Shipping companies should set up safety management systems (using the ISM Code for seagoing vessels, for example) that take into account all relevant legal and other requirements. It should be the company's policy to ensure that all jobs are done as safely and environmentally-friendly as possible, that high-risk dangerous situations are identified and preventive measures taken, that lessons are learnt from past mistakes and that these do not recur, and that the approach of all personnel towards safety and environmental protection is improved. The safety management system should be reviewed at least once a year to identify areas for improvement.

Oil companies can make standards for barges before they are accepted at their terminals. Once accepted, they should be controlled on a regular basis. A standard could be the European Barge Inspection Scheme (EBIS) checklist carried out by EBIS inspectors at the request of one of the member oil companies. The objective of the inspection report is to give an accurate assessment of the barge and her crew covering its operations at the time of the inspection. If the inspection is negative on one or more items, the tanker barge might be not allowed at the terminal.

Institutional and Capacity Building

The MRC Member Countries can make legislation where they require the shipping company of inland waterway barges to comply with the ISM Code or a similar code.

The shipping company and the master should ensure that a safety management system is observed by all employees. The master should be informed of the purpose of the system and his responsibility for its functioning including regular evaluation of its efficiency, appointing members of the Safety Committee, recording irregularities and taking corrective or preventive actions. All crewmembers must be instructed about the purpose of an effective safety management system.

3.3.3.3 Management of Security

Target group: All barges

RECOMMENDATION
Member Countries should implement an ISM or similar code compulsory for ships transporting dangerous goods.

Challenge

The security of barges carrying dangerous goods is not mentioned separately in the risk register. However, special attention is given because of an attack on two Chinese cargo vessels in the Upper Mekong on 5 October 2011. Safety and security will be strengthened along the Mekong River.

The *International Ship and Port Facility Security (ISPS) Code* is an amendment to the *Safety of Life at Sea (SOLAS) Convention* (1974/1988) on minimum security arrangements for ships, ports and government agencies. Having come into force in 2004, it prescribes responsibilities for governments, shipping companies, shipboard personnel, and port/facility personnel to "detect security threats and take preventative measures against security incidents affecting ships or port facilities used in international trade." The ISPS Code applies to ships on international voyages (including passenger ships, cargo ships of 500 GT and upwards, and mobile offshore drilling units) and the port facilities serving such ships. The main objectives of the ISPS Code are to:

- detect security threats and implement security measures;
- establish roles and responsibilities concerning maritime security for governments, local administrations, ship and port industries at the national and international level;
- collate and promulgate security-related information; and
- provide a methodology for security assessments to have in place plans and procedures to react to changing security levels;

For ships, the framework includes requirements for:

- ship security plans;
- ship security officers;
- company security officers; and
- certain onboard equipment.

For port facilities, the requirements include:

- port facility security plans;
- port facility security officers; and
- certain security equipment.

Requirements for ships and for port facilities include:

- monitoring and controlling access;
- monitoring the activities of people and cargo; and
- ensuring security communications are readily available.

Inland tankers and barges often load or unload at facilities where seagoing tankers are being handled and where the International Ship and Port Facility Security (ISPS) Code is applicable. Legislation may require inland waterway tankers and terminals to apply specific security measures. To avoid gaps in security, it is recommended these measures are harmonised with the requirements of the ISPS Code if inland tanker barges are visiting terminals and facilities where the ISPS Code is mandatory or where legislation regulates security measures. The security assessment should be made and involve the identification of existing security measures, key assets to protect and weakness in the policies and procedures, perceived threats to the tanker barge and consequences of potential incidents. Depending on the particular circumstances identified by the assessment, requirements for national or international legislation and local and national security considerations, a security plan should be made.

References

- *ISPS Code Parts A & B; and*
- *ISGINTT 6.*

ACTIONS

Technical and Management

A security plan should be made describing allocation of responsibilities for security, records of dangerous goods, statement of measures to reduce security risks (training, security policy, operating practices, equipment to reduce risks), procedures for reporting and dealing with security threats, and procedures for evaluation and testing of the security plan.

The company should appoint a company security officer to make a risk assessment and a security plan.

Institutional and Capacity Building

The respective authorities can enforce inland waterway barges to comply with the ISPS Code or other national legislation.

A designated Ship Security Officer should be appointed who has the necessary skills and training to ensure full implementation of measures required to be in place onboard the tanker. This function can be conducted by the master.

3.3.3.4 Communication and Information

Target group: All barges

RECOMMENDATION
Member countries should determine minimum safety requirements for communications equipment onboard.

Challenge

Barges are not equipped with VHF equipment and communications and information exchange depends on mobile phone use. Mobile phone use is, however, restricted and some necessary navigation info is not shared with other waterway users.

References

- *ISGINTT 22*

ACTIONS
Technical and Management

The barge should be equipped with the necessary communications systems to contact other vessels, terminals and ports. This means the installation of VHF equipment on the navigation bridge and the provision of a set of walkie-talkies, intrinsically safe in case of a tanker barge.

The owner or operator should provide all necessary equipment to ensure the safe navigation and cargo operations. This involves the provision of communications equipment and trained crew in the use of this equipment.

The crew should be made aware of the importance of correct communications and information exchange.

All tankers at the terminal should be made aware of the local security, safety and pollution prevention regulations together with other regulations relating to the safety of shipping, which the appropriate port authority may issue. There should be an exchange of information before the tanker arrives at the terminal, on a number of matters including security information and information required by port and other authorities or the terminal.

Before berthing, there should information exchange between the tanker and the terminal and/or pilot station.

Completion of safe and efficient cargo, ballast and bunkering operations depends on cooperation and coordination between all parties involved. A lot of important information should be exchanged including at what level of tank filling the operations should be stopped in order to prevent overflow or exceeding MAWP.

A safety checklist prior to any cargo operation must be filled in and signed by each party.

To ensure the safe control of operations at all times, it should be the responsibility of parties, the tanker barge and the terminal, to establish a reliable communications system. When portable VHF systems are used, these should be intrinsically safe on the tanker barge and carried by the crewmember on duty and the terminal representative. In cases where fixed systems are used, these should be continuously manned.

Before cargo operations start, the communications system should be tested. A secondary system should also be established with agreed signals "stand by", "start loading or discharging", "slow down", "stop loading or discharging" and "emergency stop". Another problem exists in case the crew and the terminal employees do not speak a common language, in which case a number of standard terms and signals must be used and understood by both parties in order to avoid any misunderstanding.

Institutional and Capacity Building

The authority should implement the installation and use of VHF equipment on barges carrying dangerous goods. A radio call sign should be assigned to each barge equipped with VHF apparatus.

A reporting system along the Mekong River should be established where all waterway traffic should inform the waterway authorities about the vessel's name and call sign, last port, destination, draught, cargo onboard and, in case of dangerous goods, the UN number and quantity, and the number of crewmembers.

Crewmembers should follow training on how to use VHF equipment, in case different languages pose a communication problem. Use of Standard Marine Vocabulary might be considered.

3.3.4 Human Elements

Target group: All barges

3.3.4.1 Manning Level and Training

RECOMMENDATION
Member countries should establish minimum education requirements for operational-level and management-level crew serving on ships transporting dangerous goods.

Challenge

The minimum safe manning level of a ship, as defined by IMO Resolution A.890 [21], should take into account size and type, construction and equipment, cargo to be carried, trading area, operation in which the ship is involved, applicable work hour limits and rest requirements, training, skill and experience of the crewmembers. All are factors that endanger the safe operation of the vessel. The minimum safe manning level should be regulated by national or international legislation stating the minimum number of crew, their required qualifications, maximum consecutive working hours and minimum rest hours. The competence of crew involved in cargo operations, especially on tanker barges should be defined and assessed. This means making the profile for the job competence depending on the function of the crewmember onboard.

The inland waterborne transport sector is an international sector where it is of utmost importance to create an equal level of quality for IWT personnel on the operational and management level. It should aim to have more structured cooperation and establish a harmonised education, training and certification system for inland waterway personnel to ensure high quality of trained staff onboard of vessels. In Europe, for example, 13 countries created Education in Inland Navigation (EDINNA) as an educational network of inland waterway (navigation) schools and training institutes at various levels.

It is generally accepted that the majority of all accidents are linked to the human element. The following table, from the US Department of Transport (1995), defines and presents the percentage of dominant human errors cited in the analysis reviews from various sources.

Table 4: **Major Causes of Accidents in the Marine Industry**

Main category	Examples	% cited in various sources
Management	Insufficient manning, faulty standards regulations, policies, practices	30
Operator status	Fatigue, inattention, vision, workload	22
Working environment	Hazardous natural environment, poor maintenance, inadequate aids to navigation, inadequate information	20
Knowledge	Inadequate general technical knowledge, inadequate knowledge of own ship handling, lack of awareness of task responsibility	14
Decision making	Faulty understanding of current situation decision based on inadequate information	14

Source: DAGOB 2006 3.2.3.2 Table 22 P.101

References

1. *IMO Resolution A.890 (21);*
2. *ISGINTT 13;*
3. *ISGINTT 15;*
4. *EDINNA; and*
5. *DAGOB 2006.*

ACTIONS

Technical and Management

Training colleges for theoretical training and barges for practical training purposes should be in place to provide the necessary education for crew working on barges handling dangerous goods.

Management should ensure that all shipboard and shore personnel involved in the transport or handling of dangerous cargoes or in the supervision thereof are adequately trained, in relation with their responsibilities within their organisation.

Management at all levels should exercise day-to-day responsibility for health and safety.

It is generally accepted that the majority of all accidents are linked to human elements such as attitude, communications problems or fatigue. It is essential, therefore, that operating procedures take the human factor into account.

Institutional and Capacity Building

All crewmembers should have a minimum level of education and training, a basic knowledge before signing on. Crewmembers onboard tanker barges, handling dangerous goods, should have specific training ensure safe operations. The training can be basic or advanced depending on the duty requirements (sailor, mate or master).

Every person should receive training on the safe transport and handling of dangerous cargoes, in relation with his duties. The training should be designed to provide familiarity with the general hazards of relevant dangerous cargoes and the legal requirements.

Training should include a description of the types and classes of dangerous cargoes, marking, labelling and placarding, packing, segregation and compatibility requirements, a description of the purpose and content of the transport documents, and a description of available emergency response documents.

Institutional and Capacity Building (continued)

Each person should receive training, proportional to risks in the event of a release of dangerous cargoes and the functions he performs, on:

1. methods and procedures for accident avoidance, such as proper use of package handling equipment and appropriate methods of stowage and segregation of dangerous cargoes;
2. necessary emergency response information and how to use it;
3. general dangers of the various types and classes of dangerous cargoes and how to prevent exposure to their hazards including, if appropriate, the use of personal protective clothing and equipment; and
4. immediate procedures to be followed in the event of an unintentional release of dangerous cargoes, including any emergency procedures for which the person is responsible and the personal protection procedures to be followed.

Such training should be provided or verified upon employment in a position involving the transport or handling of dangerous cargoes and should be periodically supplemented with retraining, as deemed appropriate by the regulatory authority.

The regulatory authority should establish minimum requirements for training and, where appropriate, qualifications for each person involved, directly or indirectly, in the transport or handling of dangerous cargoes. Regulatory authorities involved in the development or enforcement of legal requirements relating to the supervision of transport or handling of dangerous cargoes should ensure that their personnel are adequately trained, the level of training according with their responsibilities.

The minimum manning level for (tanker) barges should be regulated by the authorities as well as the required competence. To obtain this, courses should be provided and followed by examination and certification. Courses should include ship technology, safety, regulations, mechanical equipment and maintenance and handling of dangerous goods. These courses should have a theoretical as well a practical part.

The maximum number of (consecutive) working hours, the minimum number of resting hours per day, the minimum age of crewmembers should be regulated by the authorities.

The number of days crewmembers are onboard should be recorded, and controlled by the respective authorities. This can be used to check on their experience and gives possibilities in limiting the years or months of duty required to obtain a higher rank, such as from mate to master.

Important Note

The Vietnam Inland Waterway Administration (VIWA) operates three vocational schools. These are the Inland Waterway School in Nam Dong Village near Hanoi, the Inland Waterway School in Ho Chi Minh City and the Inland Waterway Technical Worker School in Haiphong.

3.3.4.2 Drugs and Alcohol:

RECOMMENDATION
Member countries should ensure that ship operators develop a drug and alcohol policy.

CHALLENGE

Recognising the potentially serious impact of marine incidents, the Oil Companies International Marine Forum (OCIMF), and the marine industry in general have developed guidance aimed at encouraging safe ship operation and protection of the environment. Guidelines for the control of drugs and alcohol onboard are in the best interests of the whole maritime industry and in doing so

ensure a safe workplace for the crewmembers and protect the safety and well being of the public and the environment.

References

Guidelines for the Control of Drugs and Alcohol Onboard Ship (OCIMF).

ACTIONS
Technical and Management

Crewmembers should be subject to testing and screening for drugs and alcohol abuse by means of unannounced testing and routine medical examinations. The frequency of these tests should be sufficient as to serve as an effective deterrent to such abuse.

The issue of alcohol onboard should be carefully controlled under the guidelines set out in the company's policy and should be monitored by the master.

The shipping companies should have a clearly written policy on drug and alcohol abuse that is easily understood by all crewmembers. Drug and alcohol policies should be clearly communicated to all personnel. To enforce their policy, companies should have rules of conduct and controls in place.

The company policy should provide for control of onboard alcohol distribution and monitoring of consumption. This policy should support the principle that crewmembers should not be impaired by alcohol when performing scheduled duties.

Institutional and Capacity Building

The authorities should check on the presence of a company policy on drug and alcohol use.

When an accident or near miss happens, personnel involved should be checked on alcohol or drug use.

The maximum allowable blood alcohol content should be agreed and put in legislation.

Information should be provided to crewmembers on alcohol consumption in relation to impairment and its impact on behaviour and health.

3.3.4.3 Personnel Protective Equipment (PPE)

RECOMMENDATION
Member countries should ensure that vessel operators provide relevant PPE of an approved type to all crewmembers.

Challenge

PPE comprises a range of clothing and equipment which is worn by crewmembers to protect or shield their bodies from workplace hazards. During the Risk Analysis it was determined that in some cases PPE was not provided or was not in a good working condition. PPE is a common name for respiratory protection, eye protection, gloves, special working clothes (such as protective clothing, thermal suits), ear protectors, safety shoes or rubber boots (steel-capped), safety helmets, protection against falls: lifelines, harnesses and lifejackets. The equipment should be used to protect the crewmembers from a risk that may threaten the safety of their health when working onboard.

Crewmembers should also be reminded that the provision of personal protective equipment does not mean that they can lower their own safety standards. The equipment does not eliminate hazards and gives only limited protection in the case of accidents. Depending on the work to be carried out, special PPE must be provided. On tanker barges when cargo operations are in progress, a lot of information,

including the kind of PPE to be used, can be found on the Material Safety Data Sheet of the cargo handled. If possible, signs must be placed where it is necessary to use PPE onboard the barge stating what kind – and possibly what type – of protective equipment to use.

References

- *International Labour Organization: Accident prevention on board ship at sea and in port.*

ACTIONS
Technical and Management

The effectiveness of personal protective equipment depends not only on its design but also on its maintenance. It should be kept in good condition and be stored in a designated place onboard. Such items should be inspected at regular intervals.

The manufacturer's instructions should be kept and consulted for use and maintenance purposes.

The Material Safety Data Sheet of the cargo onboard must be available as this provides the crew with the necessary information of the PPE to be used. Shipowners should ensure that seafarers are supplied with suitable personal protective equipment, particularly when engaged in work involving a particular hazard which can be reduced by the provision of personal protective equipment.

Institutional and Capacity Building

PPE should be of a type and standard as approved by the appropriate authority. A wide variety of equipment is available and it is essential that no items are ordered, or received onboard, unless they are suitable for the task for which they are required.

All crewmembers should be trained in the use of personal protective equipment and advised of its limitations. Persons using such items should check them each time before use.

3.3.5 Documentation

3.3.5.1 Packaged Dangerous Goods

Target group: Cargo barges

RECOMMENDATION
Member countries should determine minimum documentation standards for inland transport of dangerous goods.

Challenge

The Risk Analysis found that documentation and segregation of packaged dangerous goods transported and stored along the Mekong River is often insufficient. In 1996, **t**he IMO estimated that between 10-15 percent of cargoes transported by water are dangerous goods in packaged form including shipborne barges on barge-carrying ships, freight containers, bulk packaging, portable tanks, tank-containers, road tankers, swap-bodies, vehicles, trailers, immediate bulk containers (IBCs), unit loads and other cargo transport units. In 2000, the editor of *Hazardous Cargo Bulletin* estimated that the percentage may be higher in some ports, countries and regions.

Apart from tanker barges carrying dangerous goods in bulk, a lot of dangerous goods are carried in containers or as general cargo. From the risk analysis. it was observed that a number of barges do

not carry the required documentation for the cross-border and international transport of dangerous goods. Transport of these dangerous goods requires specific packaging, labelling, marking, segregation and a complete set of documents to ensure the safe transport and handling of the dangerous goods and a dangerous goods stowage plan, showing the exact location of the dangerous goods onboard.

Packaging Selection – Key Points

For packaged dangerous goods, appropriate packaging is vital in safely transporting dangerous goods and is regulated by a number of UN regulations and IMDG rules. All UN recommendations are based on the philosophy that securely contained dangerous goods pose little, or acceptable risk, during transport. Based on experience, the UN developed the minimum performance requirements for packaging. During the last decade, the UN has been developing packing instructions which provide detailed specifications for packing specific dangerous goods.

The following key points should be considered when selecting packaging:

1. Does it comply with the relevant code's specific requirements?;
2. Is the substance compatible with the packaging? It is the packer's and shipper's responsibility to ensure the substance is compatible with the proposed packaging. It is important the substance does not react dangerously, weaken or cause the packaging to become brittle; and
3. Has the packaging been tested to the correct test specification?

The UN felt it was necessary to know the degrees of danger, because it could affect the way a substance is handled, stowed, packaged, and transported. Because of this, the concept of Packing Groups was developed. There are three levels:

Packing Group I = High Danger

Packing Group II = Medium Danger.

Packing Group III = Low Danger

Packing Groups are always shown – on both packages and documentation – in Roman Numerals

Marking and Labelling

All codes have similar marking and labelling requirements. Labelling specifically refers to Class label(s) and Subsidiary Risk labels.

Marking refers to the UN number (preceded by the letters UN) and corresponding Proper Shipping Name. For example: "UN 2902 PESTICIDE, LIQUID, TOXIC, N.O.S. (contains 80 percent drazoxolon)".

Marks

These include special marks such as the orientation, water pollutant, environmentally hazardous and elevated temperature marks.

Segregation

The physical separation of incompatible goods helps safeguard against accidents by reducing the probability of an adverse reaction between incompatible dangerous goods if containment is lost. The

UN Recommendations recognise the need to segregate incompatible materials. However, no specific guidelines are given as these are specified in the model codes.

Container vessels should be in possession of a valid document of compliance with special requirements for ships carrying dangerous goods. The appendix to this document will contain information indicating class wise allowable locations for stowage of dangerous goods onboard.

The general provisions for segregation between the various classes of dangerous goods are shown in "Segregation Table" (IMDG Code Chapter 7.2.1.16).

Documentation – Key Points

Information required on transport documentation is essentially the same for all transport modes, although some codes require a specific form.

The following information requirement is common for all modes and should be included for each dangerous substance, material or article:

1. UN number (preceded by the letters 'UN');
2. The Proper Shipping Name;
3. The Goods' Class or Division (when assigned). Substances and articles of Class 1 (explosives) should be followed immediately by the compatibility group letter;
4. The Packing Group (if assigned);
5. Number and Type of Packages; and
6. Total Quantity of Dangerous Goods Covered by the Description (by volume, mass, or net explosive content, as appropriate).

Each dangerous cargo shipment shall be accompanied by a Dangerous Goods List or Manifest. This manifest shall be set out in accordance to the pertinent regulation of SOLAS and MARPOL conventions and the IMDG Code. Dangerous goods manifests shall be filed onboard and maintained load port wise.

Each dangerous cargo shipment shall also be accompanied by a Dangerous Goods Declaration. This is a signed certificate or declaration that the consignment, as offered for carriage, is properly packaged, marked, labelled or placarded as appropriate and in proper condition for carriage.

This declaration may be combined with the container packing certificate as required by the pertinent regulation of SOLAS and MARPOL conventions and the IMDG code. Dangerous goods declarations shall be filed onboard and maintained discharge port wise.

When dangerous goods are carried onboard, appropriate information shall be immediately available at all times for use in emergency response to accidents and incidents involving dangerous goods in transport. This information may be in the form of separate documents, safety data sheets or the Emergency Response Procedures for Ships Carrying Dangerous Goods (EMS Guide) for use in conjunction with the transport document and the Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG).

Dangerous Goods Stowage Plan

A dangerous cargo stowage plan should indicate the class and location of dangerous goods. A dangerous cargo list that indicates location, container number, class and UN number and any special guidelines from shippers should also be onboard and ready for immediate use.

References

1. *DAGOB Maritime Transport and Risks of Packaged Dangerous Goods 4:2006;*
2. *ADN; and*
3. *IMDG Code.*

ACTIONS
Technical and Management

A dangerous goods stowage plan together with a dangerous cargo list should be onboard and ready for immediate use in case of an emergency.

The MSDS should be available where the required emergency-response measures are fully explained.

A dangerous goods stowage plan together with a dangerous cargo list should be onboard and ready for immediate use in case of an emergency.

The operator should make sure that the crew has all relevant information and documentation necessary for the safe transport of the dangerous goods involved.

Institutional and Capacity Building

Authorities should implement the IMDG code or similar code to regulate the transport of packaged dangerous goods either as general cargo or in containers.

Training programmes for crew handling this cargo should be provided in nautical colleges.

Documents relating to dangerous cargo onboard are subject to scrutiny by port officials, (PSC inspectors) and other concerned parties. Thus any irregularities in such documentation may result in fines, detention or other such serious implications for the vessel.

3.3.5.2 Material Safety Data Sheet

RECOMMENDATION
Ship operator should only accept dangerous goods if the correct MSDS is provided.

Challenge

The Material Safety Data Sheet (MSDS) is often not provided for the materials onboard tanker barges (see previous section). E**ffective control over tank-barge cargo operations includes the combination of trained personnel, fully equipped and well maintained tanker barges, proper management, safe working procedures, checklists, and the necessary cargo information**. Detailed and essential cargo information can be found in the MSDS.

The MSDS is a form with data regarding the properties of a particular substance. Its purpose is to provide personnel with procedures for handling or working with that substance in a safe manner. The sheet includes information such as physical data, toxicity, health effects, first aid, reactivity, storage, disposal, (PPE) protective equipment and spill-handling procedures. Material Safety Data Sheets or Safety Data Sheets (SDS) should be provided by the supplier to assist the ship's crew in handling the dangerous cargo. The MSDS indicates the type and probable concentrations of hazardous or toxic components in the cargo to be loaded, especially H2S (hydrogen sulfide) and benzene as these often occur in petroleum products.

References

- *IMO Resolution MSC.286 (86) (adopted 5 June 2009);*
- *ISGINTT 12.*

ACTIONS
Technical and Management

The relevant MSDS should be onboard for all dangerous goods carried.

Institutional and Capacity Building

The authorities should implement the use of MSDS whenever dangerous goods are involved. Awareness of the crew handling petroleum products (and other dangerous cargoes) about the dangers of these products (toxic, flammable and explosive vapours) must be strengthened by efficient training courses and the use and content of the MSDS explained.

Specific training for tanker crew on handling dangerous goods, and use of gas measuring instruments.

3.4 RECOMMENDATIONS FOR MITIGATION

Target group: All barges

Assigned priority area in the risk register: high and very high.

3.4.1 Firefighting Equipment

Member countries should determine minimum requirements for firefighting equipment including fire extinguishers, firehoses and fixed firefighting systems onboard vessels.

Challenge

Fire requires a combination of fuel, oxygen, ignition source and a combustion. Fires are extinguished by the removal of heat, fuel or air, or by interrupting the chemical reaction of combustion. The main objective of firefighting is to reduce the temperature, remove the fuel, exclude the supply of air or interfere chemically with the combustion process with the greatest possible speed.

Firefighting equipment includes fixed firefighting installations with water, with foam and CO2 to fight fires in the engine and pump room. A number of specific portable fire extinguishers should be onboard as well as including lifelines, breathing apparatus, fire axes, helmets, fire blankets and explosion-proof safety lamps.

All barges should be provided with a fixed water firefighting system and also, depending on their use and location onboard, appropriate and sufficient portable fire extinguishers. The range of portable fire extinguishers should meet the requirements of the respective legislation and they should be in good order and available for immediate use. This requires a regular check for the proper location, the charging pressure and general condition. The fixed water-fighting system (cooling) should consist of pumps with a permanent underwater connection, a fire-main with hydrant points, firehoses complete with couplings, and jet/spray nozzles. A sufficient number of hydrants should be provided and located so that two jets of water can reach any part of the tanker.

When a tanker is alongside a berth, firefighting equipment should be ready for immediate use. Onboard the tanker, this is normally achieved byhaving fire hoses with spray/jet nozzles ready for use. Having portable dry-chemical powder extinguishers available in the cargo area provides additional protection against small flash fires. A fire control plan, showing the kind and location of all firefighting equipment, must be displayed onboard. A good working fire-detection system and fire-alarm system should also be in place.

Speed in correctly tackling a fire is vital if escalation is to be minimised and life and property safeguarded. This knowledge can only be achieved by a serious approach to training by management and operating personnel alike. Training of ship personnel, who may have to lead a fire party, should be given in shore-based fire schools where fire-extinguishing techniques can be demonstrated and practised. This training should be consolidated by frequent exercises onboard tankers and should be realistically staged. A number of barges visited showed that a lot of fire equipment was missing and, if available, was in very bad state

The requirements for firefighting equipment on vessels should be laid down by the regulations of the particular country in which the tanker is registered. For seagoing tankers and other ships, these regulations are generally based on the principles of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended. A standard for firefighting equipment for inland waterway barges could be *Directive 2006/87/EC* of the European Union, laying down technical requirements for inland waterway vessels.

References

- *ISGINTT 5, 8, 9, 24;*
- *Legislation 2006/137/EC: Directive of the European Parliament and of the Council of 18 December 2006 amending Directive 2006/87/EC laying down technical requirements for inland waterway vessels.*

ACTIONS
Technical and Management

Any barge should be equipped with necessary and adequate firefighting equipment.

Fixed fire detection systems in combination with an alarm are recommended and should be tested on a regular basis.

Firefighting equipment should always be ready for immediate use and should be checked frequently. The data and details of these checks should be recorded and indicated on the appliance. The inspection of all firefighting and other emergency equipment should be carried out by a responsible crewmember and any necessary maintenance work completed without delay.

Fire control plans must be permanently displayed in prominent positions showing clearly, and for each deck, the location and particulars of all firefighting equipment, dampers and controls.

When in port or at the terminal this plan should be available outside the accommodation for shore-based firefighting personnel:

- The fire alarm should be tested daily; and
- The MSDS of the dangerous goods onboard should be onboard as this gives specific information on how to deal with this cargo in case of fire.

Institutional and Capacity Building

The requirements for ships firefighting equipment should be laid down by the regulations of the particular country in which the tanker is registered.

Fire hoses and extinguishers should be checked on regular intervals, like every two years, and certificate issued to prove the condition.

The personnel onboard inland waterway barges should be familiar with the theory and principles of firefighting and should have instructions on the use of firefighting and all other emergency equipment, this should be certified. Practices and drills should be arranged at intervals to ensure that personnel keep their familiarity with the use and limits of the equipment. These exercises should be recorded.

All crewmembers must be able to read and understand the fire control plan.

For education of the crew a Fire Training Manual should be onboard that provides all members of the crew with general and ship specific information and instructions concerning fire safety practice and precautions, instruction in firefighting procedures, meaning of the ship's alarms, operation and use of firefighting systems and equipment and the operation and use of fire-doors and dampers[26]. (See Second edition Fire Training Manual published by I.C.Brindle & Co 2011)

3.4.2 Lifesaving Equipment

Member countries should determine minimum requirements for lifesaving equipment onboard vessels including lifebuoys and life jackets.

CHALLENGE

The lifesaving equipment onboard an inland waterway barge should include lifebuoys, life jackets, a lifeboat and an emergency alarm system. On a number of visits it was found that lifebuoys were missing and often in very bad state, also lifejackets were not available although no ship's railing was available, making work on deck dangerous.

References

- SOLAS LSA Code;
- Legislation 2006/137/EC:

  Directive of the European Parliament and of the Council of 18 December 2006 amending Directive 2006/87/EC laying down technical requirements for inland waterway vessels.

ACTIONS
Technical and Management

Every crewmember should have his own automatically inflatable life jacket, to be used in case of emergency as well when working near the ship's side like in mooring operations or on deck if the ship is not provided with a railing at the side. In case of a ferry or passenger vessel, sufficient life jackets should be provided for the maximum number of people that is allowed onboard.

A sufficient number of lifebuoys should be onboard (at least three), of which one is equipped with a self- igniting battery-powered light. The lifebuoys should be ready for use and attached to the deck at appropriate points without being attached to their mounting. Additional lifebuoys are required in case of passenger vessels or ferries.

ACTIONS
Technical and Management (continued)

A lifeboat (for barges exceeding 150t deadweight) should be onboard that can be launched by one person. Additional floating devices should be available in case of passenger vessels or ferries.

The ship's company should provide guidance on when and how to use lifejackets, as well on the maintenance of the lifesaving appliances. The use of lifesaving appliances should be experienced during regular drills and a manual on lifesaving equipment and its use should be onboard.

Institutional and Capacity Building

Authorities should establish the minimum technical requirements for inland waterway barges, this includes also place, number and kind of life jackets, lifebuoys and lifeboats.

All crewmembers should have training on the presence and use of the lifesaving appliances onboard, a first-aid training can also make part of this.

3.4.3 Emergency Response Management by Operator

ACTIONS
Member countries should ensure that vessel operators developed emergency response management (ERM) systems onboard vessels.

CHALLENGE

The Safety Management System (SMS), as it exists for seagoing vessels, requires that the company establishes procedures to identify, describe and respond to potential emergency shipboard situations, or management of emergencies. Planning and preparation are essential if personnel are to deal successfully with emergencies onboard tanker barges and cargo barges. The master and other crew should consider what they would do in the event of various types of emergency, such as fire or explosion in cargo tanks or pump room, fire in the engine room, fire in the accommodation, the collapse of a person in a tank, the tanker breaking adrift from her berth, emergency release of a tanker from her berth, oil spill (*SOPEP: Shipboard Oil Pollution Emergency Plan*), man overboard, abandon ship, collision and grounding. They will not be able to foresee in detail what might occur in all such emergencies, but good advance planning and training will result in quicker and better decisions and a well organised reaction to the situation.

The following information should be readily available:

- Type of Cargo, Amount and Disposition;
- Location of Other Hazardous Substances;
- General Arrangement Plan;
- Stability Information; and
- Firefighting Equipment Plans.

Emergency preparedness means the use of a muster list, procedures for different kinds of emergencies, and drills to have practice and knowledge of how to handle a certain emergency when it occurs. A manual should be onboard for the ship's crew containing the different emergency procedures. Emergency preparedness also involves having the necessary firefighting equipment and lifesaving appliances onboard as stated above, and crew trained in using this equipment.

In case of an oil spill, the Shipboard Oil Pollution Emergency Plan should be used. The purpose of the plan is to provide guidance to the crew onboard the barge with respect to the steps to be taken when an

oil pollution incident has occurred or is likely to occur. The plan is available to assist the ship's personnel in dealing with an unexpected discharge of oil or noxious liquid substances. Its primary purpose is to set in motion the necessary actions to stop or minimise the discharge of those substances and to mitigate its effects. An oil spill can be operational, resulting from pipeline leakage or tank overflow, or due to a casualty like grounding or a collision. Effective planning ensures that the necessary actions are taken in a structured, logical and timely manner.

Muster List

Muster lists are important and intended to provide both an effective plan for assigning personnel stations and duties in the event of any foreseeable emergency, as well as a quick visual reference that a crewmember can look at to find out where to go, what to bring, and what duties to perform in the event of an emergency. They must be posted at all times. Since no two classes of vessels or facilities are identical, muster lists must be tailored for individual vessels or facilities. Muster lists are intended to be posted in conspicuous locations throughout the vessel for the use of the crew.

Muster lists should outline the special duties and duty stations for each member of the crew, including the chain of command, for the various emergencies and should set forth the various alarm signals to be used for the calling of the crew to their stations and for giving instructions to them while at their stations. The muster list should also give relevant instructions or warnings and should be able to be seen easily under emergency-lighting conditions. The final muster list should be as simple as possible; and an accurate and up-to-date muster list should be maintained.

References

- *ISGINTT 26;*
- *Bernard Schulte Ship Management: Operational Procedures and Contingency Plans; and*
- *IMO Resolution A.760, SOLAS 74.*

ACTIONS
Technical and Management

All firefighting equipment and lifesaving equipment should be in accordance to legislation and in good working order. The alarm should also be in good working order and regularly tested. An oil spill kit must be available.

A comprehensive muster list should be posted on various places onboard, drawing the attention of all crewmembers. Every crewmember should know his task for the various emergency situations as mentioned on the muster list.

The company or operator should make emergency procedures, instruct the crew and make them aware of the importance of emergency procedures and the performance of drills.

A manual should describe the different possible emergencies and procedures and should be available for the ship’s crew for consultation.

Institutional and Capacity Building

Lifesaving appliances and firefighting equipment should be according the prevalent legislation and controlled and certified by the respective authorities.

Regular realistic drills should be conducted onboard, intervals should depend on the kind of emergency case. Drills should be recorded and evaluated.

The crew should be able to consult a manual on lifesaving appliance, firefighting equipment and techniques, a comprehensive explanation of the kind of possible emergencies onboard and the emergency procedures.

3.4.4 Emergency Response Management by Authorities

RECOMMENDATION
Member Countries should ensure that there is an adequate national authority responsible for responding to navigational emergencies along the waterway.

Challenge

The government's role, which may assume many different facets, is a very important factor in the maritime transport industry. The government influences and controls the industry in many different ways and to different extents through legal, political and financial instruments.

To manage inland waterways, ports, terminals and their traffic, a legal framework is necessary that should result in the establishment of different governmental agencies. Only in Viet Nam does such a framework exists, although implementation and control of the existing regulations is either not possible or not efficient due to various reasons such as budget constraints.

Government agencies such as inland water authority, coast guards and port authorities can issue amend, promulgate and enforce regulations. Through powers vested in their constitutions, governments exercise authority and control over dangerous goods transport, safety and health and environmental protection. This includes emergency response management. The degree of independence/interdependence, cooperation and responsibility of competent authorities within their areas of responsibility, which should be regulated by law, may vary between countries.

Emergency response by authorities is only possible if the necessary agencies exist and are fully operational.

References

- *DAGOB 2006; and*
- *Irish Coast Guard, Department of Transport.*

ACTIONS
Institutional and Capacity Building

Emergency responses can be divided into national response by inland waterway authorities and local responses by port authorities restricted to the limits of the port.

Inland Water Authorities

Inland Water Authorities Inland water authorities, which may be known as coast guards, should be national emergency organisations and may be a part of the ministry responsible for transport. The purpose should be to establish, promote and enforce safety and security standards and, by doing so, prevent as far as possible the loss of life at sea and on inland waters, and to provide effective emergency response services and to safeguard the quality of the marine or freshwater environment. The objective in relation to water pollution is to develop and coordinate an effective regime for preparedness and response to spills of oil and other hazardous substances from vessels, to provide an efficient and effective response to incidents involving casualties and to monitor/intervene in salvage operations, Such authorities can also be responsible for monitoring vessel traffic, security and illegal drug trafficking. In practice, this means that they are responsible for:

ACTIONS
Institutional and Capacity Building (continued)

- providing efficient and effective water pollution and salvage notification, monitoring and response system to co-ordinate and/or control an effective response to pollution and salvage incidents;
- establishing and maintaining national contingency plans for water pollution preparedness and response;
- approving port oil contingency plans;
- approving local authority contingency lans;
- exercising national and local contingency plans;
- prevention pollution through casualty intervention, salvage control and control of any transfer operations outside harbours and port areas by monitoring, issuing directions and taking direct action;
- on receiving information about casualties, water pollution or risk of water pollution, deciding whether a combat operation should be launched and, if so, what means or counter-measures should be to used;
- implementing and enforcing national and international water pollution legislation including gathering evidence for illegal discharges;
- Provision of national training courses on water pollution response; and
- Issuing directions or taking direct action to prevent, mitigate or eliminate pollution.

The Coast Guard or Inland Water Authority should deliver its emergency response through a mixture of declared resources and craft like patrol vessels and helicopters and services like a rescue coordination centre.

Port Authorities

Port authorities should implement, within their port limits, comprehensive emergency response plans. These should enable port facility users, such as terminals, inland waterway barges and emergency service personnel, to manage an effective and safe response to emergencies within the port's limits. They should provide guidelines for actions to be taken during an emergency to minimise the potential for loss of life, injury to people, and damage to the environment and property by covering foreseeable incidents and outlining remediation.

The objectives of emergency response plans should be to:

- provide an emergency response capability within port limits;
- offer incident assistance, coordination, communications and water transport expertise to the emergency response squad;
- facilitate training, development and response planning; and
- provide capability for exercise analysis plus incident review and response.


THAI PHAT 18

4. WATERWAYS

4.1 INTRODUCTION

Mekong navigation is characterised by a number of shortcomings that often make it dangerous and difficult. On certain river stretches it may not even be environmentally sustainable to navigate the river as the risks to tanker barges are too high. That is why spillages on the river have to be prevented from happening as the high-river flows make it too difficult to contain and clean up the spills. In Volume I (Risk Analysis), these challenges to safe navigation on the waterways, known as "waterway factors" have been analysed per stretch:

a. **Waterway geometrics:**

- rocky bottom and river banks;
- submerged obstacles like hidden rock outcrops, ship wrecks, big boulders, etc;
- narrow channels which not allowing the crossing of two vessels or overtaking;
- high bottom gradients with hidden thresholds.

b. **Hydraulics of the water flow:**

- strong funnel shaped and turbulent currents;
- side currents from tributaries of side channels.

c. **Location of the hazards:**

- upstream from important water intakes, big cities, and important wetlands;
- lakes and direction of flow.

d. Navigation, traffic, communication, man-made obstacles:

- traffic density;
- fishing nets, sand dredging operations;
- bad or no communication between ships, and between vessel and shore;
- lack of aids to navigation
- night navigation limitations;
- limited information on existing water levels and vessel traffic density.

4.2 PREPARATION OF RECOMMENDATIONS

The risks from the waterway and navigation channel itself are specific to the waterway assessment. The waterway and its natural navigation channel is a creation from nature and the risks involved in using this waterway are a direct consequence of its geometry, its physical characteristics and its hydraulic dynamics. Then there are the man-made challenges and lack of intervention which make navigating the river unsafe. The total risk encountered at a certain spot is a combination of various "waterway factors" which make navigation difficult, tricky, dangerous and perilous. These waterway factors have been ranked into a scale of pollution hazard. The real "total" danger does not stem from every single waterway factor on its own but from a combination of these factors. Every potential danger in the waterway has therefore been objectively assessed on the possibility, in case of accidents, of producing environmental damage and widespread (trans-boundary) pollution.

The final goal of the waterway assessment is to implement effective prevention measures to avoid pollution. The focus of this assessment does not relate to "physical removal of obstacles" at this stage and does not opt for any physical improvement or change of the existing navigation channels. The recommendations proposed therefore only deal with the risk assessment of the existing navigation conditions of the channel (baseline situation) and the safety of waterway assets (whether man-made or natural).

There seems to be strong environmental arguments for not focussing on navigation on a larger scale, or making the river navigable if this implies major physical changes. A key approach will be to adjust trade and vessels to the river and not the other way around. The river is, however, big enough to absorb increased traffic and still be an environment for fish and biodiversity, as long as the ambition level considers these aspects. The commission does not speak on behalf of the river, but of its member countries and the driving force in this case is increased but sustainable navigation.

4.3 RECOMMENDATIONS FOR PREVENTION

The first recommendation on the Suitability of the Waterway Sections for Tanker Barges is actually the most important one as it will restrict tanker navigation on certain stretches of the river. Hence it is crucial that the outcome of the risk analysis of the waterway is approved by all riparian countries. The other recommendations are more general proposals that will assist in preventing accidents on the river.

4.3.1 Reviewing the Waterway Assessment

RECOMMENDATION
Member Countries should ensure that waterway sections deemed unsuitable or require extra precautions for the transport of dangerous goods should be approved by the relevant line agencies.

CHALLENGE

The waterway assessment in Volume I (Risk Analysis) analysed sections of the waterway in the Upper Mekong and Lower Mekong to determine the suitability for the transport of dangerous goods by tanker barges. The waterway sections at high and low water were either deemed to be suitable, not suitable or required further precaution measures to be implemented. The transport of dangerous goods was deemed to be unsuitable from Chiang Khong to Vientiane and Pakse to Khone Falls in the Lao PDR and Thailand stretch of the river. This was due to the rapids, currents, rocky outcrops and high degree of difficulty navigating these sections. Currently, there is limited transport of dangerous goods on these stretches. The waterway assessment also found that transport of dangerous goods should be prohibited from Phnom Penh along the Tonle Sap River to Chhong Kneas during the filling of the Tonle Sap Lake. There is currently a petroleum company that operates 300-tonne inland barges for domestic supply of floating fuel stations in the Tonle Sap Lake. This requires further consultation with relevant line agencies to determine if the risks can be mitigated. The section was deemed unsuitable due to the importance of Tonle Sap ecosystems for biodiversity, fisheries productivity, agricultural land and protected wetlands.

Other areas in the waterway assessment required extra precautions due to traffic density, limited aids to navigation, unsuitability for night navigation, obstructions in the channel, sharp bends, shallow water and navigation conditions. The relevant line agencies should investigate the hazards mentioned in the waterway assessment to ensure the situation can be improved and monitored to improve waterway safety.

Three levels of risk were considered for the waterway assessment:

- **Green** = safe enough to transport dangerous goods by tanker-barges during the considered water-level conditions;
- **Yellow** = some precautions have to be taken for the transport of dangerous goods by tanker-barges. Some dangerous goods may not be allowed to be transported during "yellow" conditions;
- **Red** = unsuitable for the transport of dangerous goods by tanker-barges.

Tables 5 and 6 on the following pages summarise the Risk Analysis of the Mekong system waterways during the low-water season and the high-water season. The colour codes assigned show the suitability of navigation by tanker-barges during both seasons. These proposed levels of suitability will need to be considered and approved by the country authorities.

Table 5: **Summary of Risk Analysis for Low-Water Level Situation**

Low-Water Level Situation			Low water level	Waterway geometrics: sharp curves, rocky bootom (bedrock) and river banks, submerged obstacles like hidden rocks, vessel wrecks, big boulders, etc., narrow channels not allowing the crossing of two vessels or overtaking, high bottom gradients with hidden tresholds, etc.	Hydraulics of the waterflow Strong funnel shaped currents, strong turbulent currents, water upsruges, whirlpools, side ci = urrents from tributaries or side channels, etc.	Location of the hazard upstream from important water intakes, upstream from big cities, upstream from important wetlands; Tonle Sap and entrance of the Great Lake during flood season, upstream from special zones with protected species, etc.	Navigation, traffic, communication, man-made obstacles, etc. traffic density and presence of high speed vessels, fishing nets across the river, dredging vessels and pontoons or moored barges in the channel, bad or no communication between vessels and shore, bad or no communication between vessels, damaged aids to navigation (beacons) or misplaced buoys, busy ferry crossings obstructing long haul traffic, piers and causeways from ports and/or terminals, absence or limited information on existing water levels and traffic density, low tension high voltage cables, etc.
Golden Triangle	2,373	Chiang Saen	2,364				
Chiang Saen	2,364	Chiang Khong/Huay Xay	2,314				
Chiang Khong/Huay Xay	2,314	Pak Beng	2,172				
Pak Beng	2,172	Luang Prabang	2,010				
Luang Prabang	2,010	Pak Lay - Vientiane	1,585				
Vientiane	1,585	Savannakhet	1,126				
Savannakhet	1,126	Pakse	869				
Pakse	869	Khone Falls	721				
Khone Falls	721	Steung Treng	684				
Steung Treng	684	Kratie	561				
Kratie	561	Kompong Cham	448				
Kompong Cham	448	Phnom Penh	348				
Phnom Penh	348	Border Viet-Nam	251				
Border Viet-Nam	251	Tan Chau	236				
Tan Chau	236	My Tho	74				
My Tho	74	Deep Sea Buoy					
Mekong-Vam Nao Intersection	216(*)	Long Xuyen	162				
Long Xuyen	162	Can Tho	109				
Can Tho	109	Deep Sea Buoy	-				
Phnom Penh	-	Kompong Chhnang	99				
Kompong Chhnang	99	Chhong Kneas	204				

216(*) = km distance along the Mekong mainstream

Table 6: **Summary of Risk Analysis for High-Water Level situation**

High-Water Level Situation			High water level	Waterway geometrics:	Hydraulics of the waterflow	Location of the hazard	Navigation, traffic, communication, man-made obstacles, etc.
				sharp curves, rocky bootom (bedrock) and river banks, submerged obstacles like hidden rocks, vessel wrecks, big boulders, etc., narrow channels not allowing the crossing of two vessels or overtaking, high bottom gradients with hidden tresholds, etc.	Strong funnel shaped currents, strong turbulent currents, water upsruges, whirlpools, side ci = urents from tributaries or side channels, etc.	upstream from important water intakes, upstream from big cities, upstream from important wetlands, Tonle Sap and entrance of the Great Lake during flood season, upstream from special zones with protected species, etc.	traffic density and presence of high speed vessels, fishing nets across the river, dredging vessels and pontoons or moored barges in the channel, bad or no communication between vessels and shore, bad or no communication between vessels, damaged aids to navigation (beacons) or misplaced buoys, busy ferry crossings obstructing long haul traffic, piers and causeways from ports and/or terminals, absence or limited information on existing water levels and traffic density, low tension high voltage cables, etc.
Golden Triangle	2,373	Chiang Saen	2,364				
Chiang Saen	2,364	Chiang Khong/Huay Xay	2,314				
Chiang Khong/Huay Xay	2,314	Pak Beng	2,172				
Pak Beng	2,172	Luang Prabang	2,010				
Luang Prabang	2,010	Pak Lay - Vientiane	1,585				
Vientiane	1,585	Savannakhet	1,126				
Savannakhet	1,126	Pakse	869				
Pakse	869	Khone Falls	721				
Khone Falls	721	Steung Treng	684				
Steung Treng	684	Kratie	561				
Kratie	561	Kompong Cham	448				
Kompong Cham	448	Phnom Penh	348				
Phnom Penh	348	Border Viet Nam	251				
Border Viet Nam	251	Tan Chau	236				
Tan Chau	236	My Tho	74				
My Tho	74	Deep Sea Buoy					
Mekong-Vam Nao intersection	216(*)	Long Xuyen	162				
Long Xuyen	162	Can Tho	109				
Can Tho	109	Deep Sea Buoy	-				
Phnom Penh	-	Kompong Chhnang	99				
Kompong Chhnang	99	Chhong Kneas	204				

216(*) = km distance along the Mekong mainstream

4.3.2 Minimum Safety Requirements for Navigation and Communication Equipment

RECOMMENDATION
Minimum safety requirements for navigation and communication equipment should be established for tankers transporting dangerous goods in the Mekong River system to improve waterway safety.

CHALLENGE

It was found that vessels operating in the Upper and Lower Mekong have limited navigation and communication equipment. It is important for operations that ports authorities and terminal operators know the location of vessels for planning of operations. Navigation equipment can be essential in preventing collisions and groundings. Further information is on the minimum requirements of navigation and communication equipment for vessels in specified in Chapter 3.

4.3.3 Evaluate Current Aids to Navigation

RECOMMENDATION
Evaluate the current aids to navigation system and determine locations where further installation of buoys and beacons are required including Visual Low Water-Alert Gauges which should be installed at navigation bottlenecks to provide guidance to the skippers.

CHALLENGE

A study is required to do inventories all existing aids to navigation, such as buoys and beacons, shore marks and other simple navigational aid assistance, and identify what is required for further installation. In 2009–2010, the Navigation Programme undertook brief condition surveys in the Lower Mekong from Kompong Cham to Phnom Penh, from the Cambodia-Viet Nam border through the Vam Nao Pass to Can Tho Port for improving navigation and from Vam Nao Pass to the sea. The condition surveys included topo-hydrographic surveys, navigation channel designs and designs for aids to navigation and electronic navigation charts. Aids to Navigation (day and night) system were installed in some stretches but not enough. Along the Upper Mekong River, aids to navigation (day) have also been installed from Huay Xay to Luang Prabang to Vientiane.

The aids to navigation system requires further improvement. A review is needed on the effectiveness of the existing aids to navigation system to determine areas where more buoys and beacons are needed. The review should consider the further implementation of modern technologies to improve waterway safety such as GPS and Automatic Identification Systems (AIS). These items are explained further and in the Chapter on Vessels in Volume I. In the first instance, these technologies should be fitted to vessels carrying dangerous goods and for passenger transport.

In the field of physical improvement of the navigation channel marking, there is actually no visible way of informing the skippers of the water level at the time of their passage. A useful way of informing skippers and helmsmen of the available water depths is derived from the condition surveys of dangerous areas for navigation between Huay Xay and Luang Prabang and between Luang Prabang and Pakse. An easily recognisable solid construction that is clearly visible along the shore up and downstream of shallow areas in the navigation channel can give valuable information to skippers or pilots on the actual water level at the time of passage. Chart datum is known to be the average of the lowest low-water levels over a sufficiently long period of time. All hydrographic maps show the water depths related to the chart datum (zero level) at a particular location. By adding the height of the water level at the time of passage to the LAD (least available water depth in the particular stretch)

pilots can easily calculate the available water depth at the time of passage by reading the water level at the shore mark.

Easily recognisably solid constructions are only necessary in the beginning and at the end of the dangerous areas which are known to be shallow. Such "monuments" have to be visible from the navigation channel. Visibility can eventually be increased with paint. In very wide and shallow areas, the shore mark might be kilometres away from the sight of the skippers and pilots so good positioning is an important factor of this new aid to navigation tool.

4.3.4 Installation of Aids to Navigation System as Required

RECOMMENDATION
Based on the evaluation of the current physical aids to navigation study, install buoys and beacons where required.

CHALLENGE

There is a serious lack of suitable and modern visual aids to navigation (see Section 4.3.2 above). The MRC has made remarkable progress in this field with day and night aids to navigation between the port of Phnom Penh and the Cambodian-Viet Nam border (2007), buoys on the Bassac River and Vam Nao Pass in Viet Nam (2009) as well as the aids to navigation systems between Vientiane and Luang Prabang (2009) and between Luang Prabang and Huay Xay (2011). Some of the new equipment needs further fine tuning, however, and some buoys have to be relocated/repositioned upon request from the pilots.

However, much more needs to be done as many stretches are still without proper and modern channel markers.

4.3.5 Development of a GPS Vessel Guidance System

RECOMMENDATION
A GPS Vesssel Guidance System should be developed and installed on the stretches of the Mekong River in the Lao PDR and Thailand between the Golden Triangle and Pakse, and in Cambodia between Steung Treng and Kompong Cham.

CHALLENGE

Physical marking of the navigation channel of the Mekong River in the Upper sections in the Lao PDR and between the Lao PDR and Thailand has not been an easy or effective task. Installing aids to navigation in extremely dangerous sections has been considered. However, the complexity of the waterways in these regions and the large number of dangerous stretches makes this option prohibitively expensive. The large seasonal variability in water levels and substantial amount of flood debris in the wet season mean that unless the markers are removed and replaced during periods of peak flows, there is a high probability of equipment damage or loss. The Middle/Upper Mekong River is difficult to navigate because of the numerous rocks and rocky outcrops, and because of the changing river levels that submerge the obstacles. These factors all create a challenging environment for maintaining a safe and reliable channel marking system in the Upper Mekong.

An alternative approach to vessel guidance is therefore necessary on these stretches. Rather than relying on the physical markers and their associated maintenance and cost challenges, navigators should utilise new low-cost technologies in the form of GPS course guidance and identification of submerged hazards. Working with the already skilled navigators of river-faring vessels, the optimal course for wet and dry seasons could be recorded and displayed on a digital chart, providing a visual

tool that would allow navigators to ensure they are on course, and alert them of any hazards that might be approaching. By recording an ideal course with outer limits for safety and overtaking, it is possible to provide an accurate level of route guidance, whilst allowing for potential GPS accuracy issues. This system would allow the navigator to keep the vessel on a predetermined track and avoid underwater obstacles and rocky outcrops. During heavy rains, which seriously reduce visibility, the navigator could still reach the safety of port by steering with assistance from the digital chart.

The proposed system would incorporate a number of other advantages:

1. **The Estimated Time of Arrival (ETA) of vessels could be calculated with great accuracy as the pilots could determine instantly the distance remaining to reach the next destination;**
2. **Vessels could sail cautiously in conditions with bad visibility caused by dense rain, fog, and from sailing during twilight hours;**
3. **In emergency situations, vessels could continue to sail in extreme weather such as heavy rain and winds; and**
4. **Governments could have control and registration of accidents by checking the GPS readings and tracking logs of vessels. This data would be extremely useful during accident investigations.**

Vessels could continue to sail into the late evening and night just to reach a safe port. Due diligence would be required, however, as it is strongly advised only to sail during daylight hours.

An initial "project area" along a stretch of river will provide an initial opportunity to test the technology and survey methodology to ensure its suitability for use in navigating the river. If this project is successful, the technology will be expanded to cover other stretches that are not suited to physical marking, including upstream from Huay Xay and downstream from Luang Prabang in Thailand and Lao PDR to Kompong Cham in Cambodia. From Kompong Cham downstream to the sea, navigation is easier as the gradient of the river flattens out, the riverbed is less rocky, and buoys and beacons work effectively there.

Data collected from the early stages of the project must be combined with other spatial datasets. These include the updated digital hydrographic atlas which is then uploaded to the GPS units to provide a resource of hand-held devices containing a universal navigation dataset of the basin for use in future projects and research

A bathymetric survey using a combination of Side-Scan Sonar technology with Single-Beam Echosounding should be conducted to verify the safety of the above identified course lines. The proposed survey area should extend to a maximum of 30m either side of the course line identified during the assessment stage. Sounding data should be collected during the sidescan survey, with information from the sidescan monitor used to direct the focus of the survey to collect concentrated depth information of rocks and other hazardous objects. If necessary the traditional navigation channel should be realigned to avoid any dangerous obstacles. However, any such realignment should be as minor as possible to preserve the general alignment of the traditional route.

The results of the bathymetric survey should be analysed using software tools (ArcGIS, Hypak, etc) to interpolate a surface of the riverbed within the navigation corridor.

An advanced GPS mapset should also be produced to create a comprehensive graphical map set of the project area. This information should be integrated with data layers from the existing hydrographic atlas and updated chart datum determination to produce graphical maps that can be displayed on large screens GPS instruments.

It is important to note that this system is only a help for the vessel itself. River management and port services have no knowledge of the vessel's position and the vessel itself has no knowledge of other

vessels in its neighbourhood or on its course. GPS is therefore seen as a valuable tool assistance for correctly positioning the ship in the channel.

4.3.6 Automatic Identification System (AIS)

RECOMMENDATION
AIS transponders should be installed on all tankers along the Mekong River in Cambodia and Viet Nam.

CHALLENGE

The Automatic Identification System (AIS) is an automated tracking system used on ships for actively (transceivers) identifying and locating vessels along the waterways. The system makes use of electronically exchanged data with other nearby ships and shore stations. AIS equipment complements marine radar information, which is still the primary method of collision avoidance between vessels s and identifying the outer dimensions of the waterway. AIS transmits, automatically and at set intervals, dynamic information relating to the vessel's course, speed and heading; static information related to the vessle's name, length, breadth; and voyage-related details such as cargo information and status (underway, at anchor). AIS is a Very High Frequency (VHF) radio-broadcasting system that transfers packets of data over the VHF data link and enables AIS-equipped vessels and shore-based stations to send and receive identification information that can be displayed on a computer or chart plotter.

There are two classes of AIS: Class A and Class B. Class A has been mandated by the International Maritime Organization (IMO) for vessels of 300 gross tonnage and upwards engaged on international voyages, cargo ships of 500 gross tonnage and upwards not engaged on international voyages, as well as passenger vessels (more than 12 passengers), irrespective of size. Class B provides limited functionality and is intended for non-SOLAS vessels. It is not mandated by the International Maritime Organization (IMO) and has been developed for non-SOLAS commercial and recreational vessels.

Although this rule does not apply on river navigation, it is strongly recommended that the same regulation should apply on all vessels transporting dangerous cargoes and all passenger vessels.

A new generation of low-cost AIS transceivers could initiate a positive evolution in improving the safety of navigation in the Mekong countries, particularly in the Mekong Delta in Viet Nam. Navigation here is often extremely dense (in the neighbourhoods of ports, terminals and big cities) and the movements of bigger seagoing vessels a real challenge.

However, the geometry of the terrain may be a hindrance to good transmissions when ships are hidden behind steep rocks or in canyon shaped channels. VHF/UHF frequencies require clear view to transmit the signals.

4.3.7 Assessment of Main Domestic IWT Routes in Viet Nam

RECOMMENDATION
Undertake further waterway assessment to determine the suitability of the 13 main domestic IWT routes in Viet Nam for the transport of dangerous goods.

CHALLENGE

The waterway assessment in Viet Nam included only the Mekong and Bassac Rivers and the Vam Nao Pass and does not include the 13 main domestic IWT routes. The scope of the project was to include only the Mekong and Bassac River. In the future, the same methodology can be used to assess the 13 main domestic IWT routes in Viet Nam.

4.3.8 Establish Emergency Response Mechanisms along the Waterway

RECOMMENDATION
Feasibility study for the Member Countries to establish emergency-response mechanisms along the waterway to respond to navigation accidents, oil spills and security-related incidents along the Mekong River.

CHALLENGE

Member Countries have either no or very limited emergency-response mechanisms to monitor inland and navigation activities and respond to security incidents, navigation accidents, oil spills and other major incidents. Early-warning, notification and emergency-response systems should be enhanced in all the Member Countries taking into account in existing national policies, National Disaster Committees, ASEAN Disaster Response Preparedness and other regional agreements. The Member Countries are currently drafting Water Quality Emergency Procedures and it will be important that transport of storage and dangerous goods are included.

In Viet Nam, the Central Rescue Centre is in Ho Chi Minh City and there is no dedicated rescue centre covering inland waterways in the Mekong Delta. Priority areas in the Mekong Delta will recommend that further emergency response is established for oil spill response and navigational emergencies on the Mekong and Bassac Rivers. Emergency response in Cambodia is very limited and there is no procedure to deal with emergency situations involving cross-border transport. Thailand and Lao PDR has limited emergency response for navigational accidents and oil spill pollution. Following security incidents in the Upper Mekong, the People's Republic of China is playing a more active role in monitoring of waterways to increase security. This could be extended to environmental protection, waterway safety and emergency response.

Taking into account the current navigation activities and transport of dangerous goods in the Member Countries, emergency-response units could be established at:

- **Chiang Saen Port II in Thailand**, to respond to emergencies in the Upper Mekong, including Chiang Kong and Huay Xay;
- **Luang Prabang in Lao PDR** to focus on waterway emergencies, passenger and cruise vessels;
- **Phnom Penh Port in Cambodia**; and
- **Can Tho or My Tho in Viet Nam** to complement the Central Rescue Unit in Ho Chi Minh City. Consultations indicated the need for a Central Rescue Unit in the Mekong Delta. In terms of mitigating trans-boundary pollution and incidents it could also be worth considering an emergency response unit at the Cambodia-Viet Nam border area.

Establishing emergency response mechanisms in the Member Countries will be a significant outcome and require a detailed feasibility study and further investments in institutional strengthening, capacity building and equipment.

4.3.9 Standard Accident Reporting and Recording System

RECOMMENDATION
Member Countries should develop a standard accident reporting and recording system for navigation accidents, oil spills, security related and other incidents.

CHALLENGE

Accurate accident data is not presently available for IWT in the Member Countries. However, reports from local authorities and communities confirm that there have been accidents resulting in oil spill pollution, loss of cargo, fires and other incidents. A standard accident reporting and recording system should be implemented to ensure the effective investigation of incidents, to prevent any reoccurrence and to share lessons learned throughout the inland waterborne transport sector. An accident recording database should be established to enable accurate incident data for analysis to highlight trends and priority areas for developing safety and environmental measures to mitigate risks. The standard accident system can be used to record incidents related to oil spills, loss of cargo, injuries, fatalities, fires, security related and other incidents.

In transport and definitely in inland shipping worldwide, the use of Information and Communication Technology (ICT) is dramatically increasing. ICT is potentially an important instrument for promoting transport over water. It can provide inland shipping with a competitive edge over road transport. In the European context, a concept for harmonised information services to support traffic and transport management in inland navigation including interfaces to other transport modes has been developed under the name of River Information Services (RIS). An important aspect is that the RIS structure also allows information sharing with transport companies, thus enhancing the efficiency of transport management.

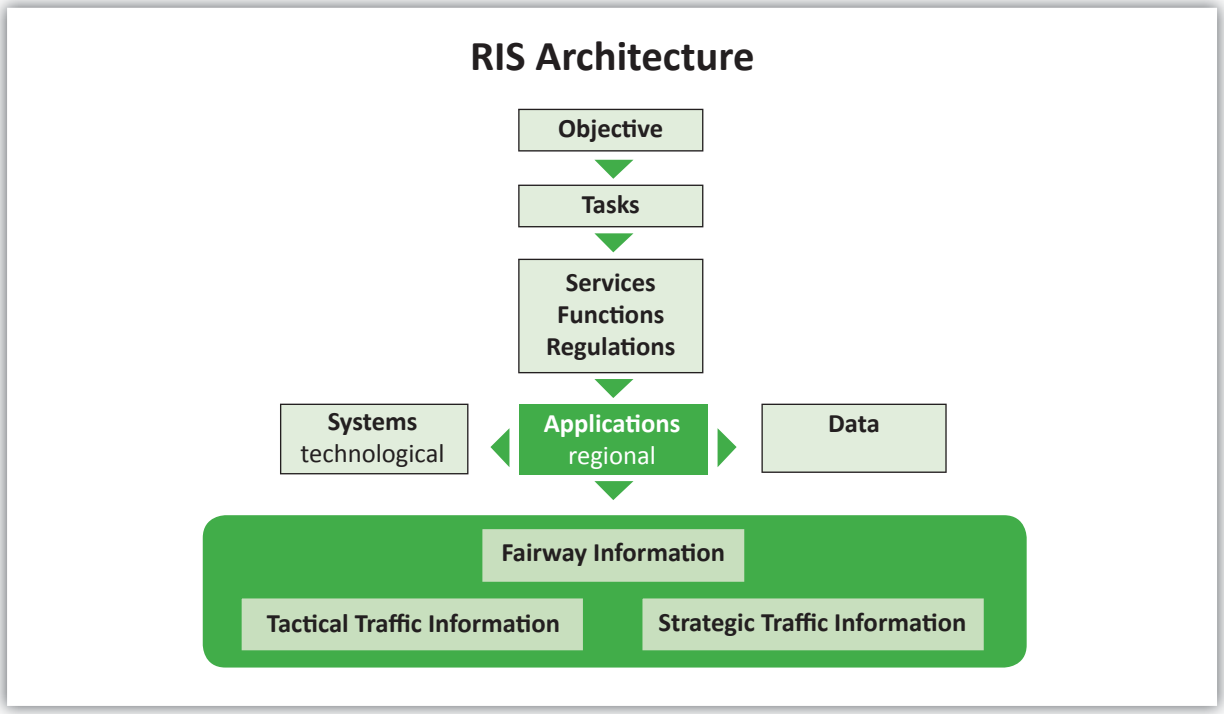
In view of the different level of navigation development in the riparian countries, an advanced ICT system in the LMB would only be effective and feasible once the transport infrastructure network and services are in place. However, to avoid a situation where the countries install a different system, MRC could ensure that the basic functions of River Information Services could be in place based on a standardised system. This means at first there will be a focus on (1) standardising, harmonising, collecting, analysing and processing data and (2) a part of the system packages such as disseminating the most needed information, including water-level forecasts and initial steps for voyage planning.

Once the development of regional navigation is well underway, the basic functions of the RIS can be expanded to allow for more advanced technological modules such as electronic charting and traffic management and vessel monitoring systems.

Before any regional services can be carried out, there should be a standardised and harmonised system. To fully benefit from RIS, it is necessary that different information systems are interchangeable and capable of mutual communication. Even if a country chooses develop its own system with special functions, it is advisable to adhere to a minimum set of basic principles. These basic principles are laid down in the data and communications standards. Once all parties adhere to these standards all over the LMB, authorities and industry will be able to exchange data. This will mean substantial cost savings by abandoning the costly development of interfaces for the authorities and shippers. Without standards, the industry will probably not launch applications on the market when standards are changing. Standardization of data will allow better resource management, deliver innovative products and services and will provide the tools, knowledge, and technological capabilities to take care of business and the environment. In short, RIS will:

- **enhance the safety of inland navigation** in ports and rivers in a preventive sense and contributes to any remedial measures, which are deemed necessary by the competent authorities,
- **protect the environment** by providing, among others, dangerous goods information to the competent authorities assigned to combat pollution within a pre-defined response time,

- **expedite inland navigation, optimise inland port resources and manage traffic flows**,
- **prepare a Mekong Cooperation framework on navigation data standards** and harmonisation for more effective use and easy interchange,
- **build infrastructure to exchange information** to vessels concerning relevant resources and the state of these resources of the ports.



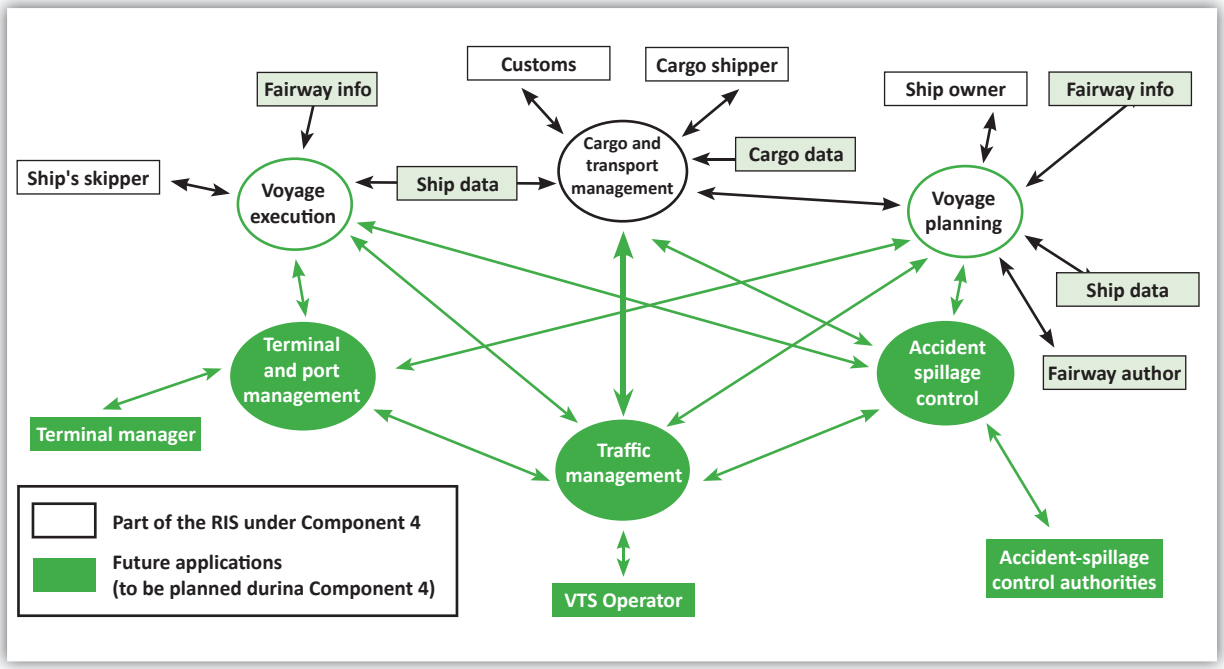


Figure 18: RIS Applications and data flow diagram

4.4 RECOMMENDATIONS FOR MITIGATION

4.4.1 Enhance Emergency Response Planning and Existing Fire Emergency Response Authorities

RECOMMENDATIONS
Member Countries should enhance emergency response planning and enhance the capacity of existing fire and emergency response authorities in relation to potential major incidents at petroleum terminals.

CHALLENGE

The capacity of emergency-response authorities needs to be improved to respond effectively to major fire and explosions incidents in collaboration with the private operators of ports and petroleum terminals and local communities. Fire and emergency drills should be performed on a planned basis and reviewed to ensure continual improvement. The emergency response and contingency planning should also involve consultation with national line agencies, emergency response authorities and local communities. Emergency response planning for ports and petroleum terminals is covered in detail in Chapter 2.2 (Ports and Terminals).

4.4.2 Navigation Charts

RECOMMENDATION
Navigation Charts to be prepared, with GPS navigation system. Very detailed bathymteric surveys only in the navigation channel.

CHALLENGE

Some charts need serious updating, and use of multibeam scan because of the multitude of rocks in the channel.

4.4.3 Training Needs Assessment and Training

RECOMMENDATION
Waterway engineers, planners, waterway maintenance and surveyors should be trained and certified.

CHALLENGE

A Training Needs Assessment should be conducted to identify in detail what is actually required for training of skippers (see Chapter on Vessels), waterway design engineers, waterway maintenance personnel, planners and surveyors, and how to certify them.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5. LEGAL FRAMEWORK

The Risk Analysis reveals that the current legal regime pertaining to transport of dangerous goods on the Mekong is imperfect, with important gaps and major differences between the riparian countries. Important aspects of the transportation of dangerous goods by inland waterways such as, inter alia, dangerous goods packed in limited quantities, construction and testing of packaging, training of crew (with the exception of Vietnam), rules for the construction of vessels and segregation of dangerous goods (with the exception of Vietnam), are not covered by the current regime.

As a result, it would appear that there is a case for the establishment of comprehensive, harmonised and up-to-date legal rules on the transportation of dangerous goods along the Mekong River.

5.1 HARMONISING STANDARDS, RULES AND REGULATIONS

RECOMMENDATION
Rules and regulations on the waterborne carriage, storage and handling of dangerous goods along the Mekong River should be harmonised.

CHALLENGE

This first and quite fundamental recommendation is to the effect that rules and regulations for the transportation of dangerous goods on the Mekong be harmonised. This need for harmonisation has already been acknowledged by all riparian states and was moreover considered very high priority.

5.2 AGREEMENT FOR HARMONISING RULES AND REGULATIONS

RECOMMENDATION
Harmonisation of rules and regulations on the transportation of dangerous goods on the Mekong should be implemented either through (1) a specific dangerous goods agreement to be concluded by the four MRC Member States or (2) separate agreements to be concluded by (a) Cambodia and Viet Nam and (b) the Lao PDR and Thailand.

CHALLENGE

Each riparian country is currently responsible for the adoption of national rules and regulations on the waterborne carriage, handling and storage of dangerous goods for its own stretch of the Mekong River.

With a view to the harmonisation of such rules and regulations, the countries could agree on a specific quadripartite dangerous goods agreement between all the MRC Member States.

An alternative is to develop separate agreements (or common rules and regulations) for the Lower and "Middle Mekong". Cambodia and Viet Nam could conclude such an agreement or adopt harmonised rules and regulations through the Mekong Navigation Facilitation Committee. Lao PDR and Thailand could sign a similar agreement or adopt harmonised rules and regulations on the basis of a future comprehensive bilateral agreement on safety of navigation.

The alternative of adopting separate instruments can be based on the following arguments:

- Currently, there are two up-to-date legal agreements on navigation in the Mekong River Basin;
- The Khone Falls form a natural geographical boundary;
- The physical characteristics of the waterways and the ships operating on the Upper (and Middle) Mekong and the Lower Mekong differ; and
- The harmonisation of the aids to navigation systems has followed a similar approach.

With regard to the first argument, it should be borne in mind that currently, there is no up-to-date legal regime for the stretch of the Mekong between Luang Prabang and Khone Falls. If Thailand and Lao PDR would conclude a new agreement with regard to this stretch, this would result in three different legal regimes for navigation in the Mekong River Basin. Nevertheless, in case of such a new agreement for the "Middle Mekong", the other three arguments set out above remain valid and a distinction between the stretch upstream of the Khone Falls and the stretch downstream of the Khone Falls would remain relevant.

It should be kept in mind that road and ferry transportation of dangerous goods is already covered by the 1999 *Agreement for Facilitation of Cross-Border Transport of Goods and People,* and its Annex 1 on carriage of dangerous goods (the entry into force and the exact scope of which have to be studied further. This Agreement was signed/acceded to by six countries including China and Myanmar). In order to avoid overlaps or contradictions with existing GMS-CBTA (Annex 1), consultation with ADB - GMS is advisable.

The existing Quadripartite Agreement on the Upper Mekong (to which China and Myanmar are Parties together with Lao PDR and Thailand) should be taken into account as well. Whether the proposed regime for the Middle Mekong can or indeed should be identical to the regime in place for the Upper Mekong remains to be investigated.

5.3 INTERNATIONAL STANDARDS FOR DANGEROUS GOODS RULES AND REGULATIONS

RECOMMENDATION
Rules and regulations on dangerous goods should conform to applicable international standards such as IMDG (for maritime transportation) and, as far as feasible, relevant UN or IMO rules and recommendations and the ADN Agreement.

CHALLENGE

With a view to legal certainty and maximum trade facilitation, harmonised rules on the transportation of dangerous goods on the Mekong should conform to worldwide international legal and technical standards.

Thailand, Cambodia and Viet Nam already comply with the IMDG Code at maritime ports. Probably, the application of the IMDG Code can be extended to include major inland ports and be integrated with existing road and rail networks.

With regard to vessels, reference can be made to the following instruments (some of which were adopted at IMO level as well):

- *Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk;*
- *International Code for the Construction and Equipment of Ships carrying Liquefied Gases in Bulk*
- *Code for Existing Ships Carrying Liquefied Gases in Bulk;*
- *International Safety Guide for Inland Navigation Tank-barges and Terminals.*

With regard to guidelines for ports and terminals, reference should be made to the *ILO Code of Practice on Safety and Health in Ports,* 2003 (see Chapter 6.2.4 of Volume I) and *IMO Revised Recommendations on the Safe Transport of Dangerous Cargoes and Related Activities in Port Areas*, 2006 (see Chapter 6.2.5 of Volume I).

The relevance of each of these instruments for the Upper Mekong and the Lower Mekong as well as the feasibility of implementing these instruments should be investigated further.

In Europe, a general tendency towards harmonisation of rules on the transportation of dangerous goods by inland waterways has emerged, with a key role for the *European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN)*. The ADN was drafted by the United Nations Economic Commission for Europe (UNECE), in close cooperation with the Central Commission for the Navigation of the Rhine (CCNR). Currently, 17 countries are party to the ADN.

The advantages of using the ADN as a basis are:

- international transportation of dangerous goods is permitted if the conditions of the annexed Regulations are met;
- riparian States retain the right to regulate or prohibit entry on their territory for reasons other than safety during carriage;
- other regulations applicable to carriage of goods in general remain applicable;
- a possibility exists for derogations through bilateral/multilateral agreements; and
- a possibility exists for special authorizations.

The example of the draft *Prakas on Technical Requirements for Carriage of Dangerous Goods by Inland Waterway in the Kingdom Of Cambodia* moreover shows that there is awareness of the ADN within the Mekong Basin. The suitability of implementing the ADN Code should be investigated taking into account the Upper Mekong and Lower Mekong, institutional capacity, technical standard of existing fleets and the socio-economic development. The implementation of the ADN Code would need to be undertaken in a feasible and practical manner. As a separate action, capacity building with a view to raising awareness of international standards is recommended.

5.4 SAFETY CODE FOR TRANSPORT OF DANGEROUS GOODS

RECOMMENDATIONS
In addition to legally binding rules, a harmonised non-binding Safety Code for the Transport of Dangerous Goods Along the Mekong River should be developed.

CHALLENGE

In addition to legally binding harmonised rules, a harmonised non-binding *Safety Code for the Transport of Dangerous Goods* along the Mekong River should be developed. Such a Code could set out best practices, referring to international standards. Also, it should be updated on a regular basis.

5.5 INSTITUTIONAL CAPACITY

RECOMMENDATIONS
The institutional capacity of national line agencies for compliance and monitoring should be enhanced.

CHALLENGE

All Member Countries identified that one of the main problems with the transport of dangerous goods is the limited capacity of institutions and national line agencies to enforce national rules and regulations. For example, Viet Nam has an extensive legal framework. However, there is limited guidance on how to effectively apply and implement these laws in a practical manner. There are difficulties on how to control and monitor the implementation of the rules and standards with limited budgets and resources. Capacity building is required for all Member Countries to ensure a better understanding of how the rules and regulations are to be implemented. The technical capacity and resources required of the line agencies to effectively monitor and enforce the rules and regulations also should be determined. National line agencies also raised concerns about accessing private ports and petroleum terminals.

For these reasons, capacity building with a view to attain equal capacity among all MRC Member Countries is a matter of urgency.

5.6 PUBLIC INFORMATION AND PROMOTION CAMPAIGNS

RECOMMENDATION
Public information and promotion campaigns for all waterway users on dangerous goods, oil spill pollution and safety should be undertaken.

CHALLENGE

Awareness was determined as a very high priority area in all of the Member Countries at ports, terminals, vessels and the importance was again stressed at National Consultation Meetings. Lack of awareness contributes significantly to the increased risks of fire, explosion, injury, loss of life and pollution. The level of understanding of the risks associated with dangerous goods needs to be improved significantly for all waterway users.

Public information campaigns should be delivered to key stakeholders (including port authorities, shipping operators, petroleum companies and waterway users) to improve understanding and awareness on dangerous goods, environmental protection and waste management. The campaigns should be published in all four languages of the Member Countries and tailored towards national line agencies, key stakeholders and all waterway users. For example, promotion campaigns and industry

forums should be established to encourage petroleum and shipping companies to invest more budget and resources towards safety and environmental protection. For small vessel operators awareness programmes could focus on correct disposal of solid and liquid wastes and the risks of fire and pollution.

5.7 MINIMUM SAFETY REQUIREMENTS FOR VESSELS IN UPPER MEKONG

RECOMMENDATION

The competence of riparian authorities under the Lancang-Mekong Agreement on Commercial Navigation to inspect vessels operating in MRC Member Countries in relation to minimum safety requirements should be examined further.

CHALLENGE

Volume I (Risk Analysis) identifies Chiang Saen Port and national line agencies as having limited capacity to inspect the inland barges from China and Myanmar. A number of vessels do not meet minimum safety requirements and increase the risks of pollution, fire and navigational accidents. The *Agreement on Commercial Navigation on Lancang-Mekong River* contains a mechanism for the establishment by the Riparian States of "common" rules on the transportation of dangerous goods on the Upper Mekong. It remains to be investigated how in practice these laws are applied or whether national line agencies have the necessary powers to inspect the conditions and operations of foreign flag vessels prior to loading and discharging dangerous goods in the Upper Mekong. Also, there is a clear need for training of inspectors and their trainers.

5.8 EXISTING RULES AND REGULATIONS FOR TRANSPORT OF DANGEROUS GOODS

RECOMMENDATION

A detailed legal study of the legal framework related to the carriage, handling and storage of dangerous goods in Viet Nam should be carried out.

CHALLENGE

Viet Nam has the most extensive legal instruments for IWT. However, a full legal review needs to be undertaken to determine the rules, decrees and circulars that specifically apply for transport of dangerous goods. It was identified during the Risk Analysis and the National Consultation Meetings that there are difficulties identifying and complying with the extensive and complicated legal framework. The review needs to include information on how the rules and regulations are implemented and the national line agencies responsible for monitoring and compliance. There are often overlapping responsibilities between the VIWA and VINAMARINE which limited the implementation of some rules and regulations for IWT.

5.9 DRAFT RULES AND REGULATIONS FOR TRANSPORT OF DANGEROUS GOODS IN CAMBODIA

RECOMMENDATION
The draft Cambodian rules and regulations on dangerous goods should be coordinated with the existing Vietnamese rules and regulations on dangerous goods on the basis of the Cambodia-Vietnam Agreement on Waterway Transportation.

CHALLENGE

The MPWT in Cambodia is currently drafting the *Law on Inland Water Transport* and a draft *Prakas on Technical Requirements for the Transport of Dangerous Goods in Cambodia*. Rules and regulations in Viet Nam for transport of dangerous goods should be considered prior to implementing the national regulation in Cambodia to enable standards to be harmonised. The 2009 *Agreement on Waterway Transportation* specifically instructs the Mekong Navigation Facilitation Committee (MNFC) in Cambodia and Viet Nam to make proposals for the adoption by the Contracting Parties of harmonised rules and regulations on the transportation of dangerous goods.

5.10 DRAFT RULES AND REGULATIONS FOR TRANSPORT OF DANGEROUS GOODS IN LAO PDR

RECOMMENDATION
Rules and regulations for safe transport of dangerous goods in Lao PDR should be reviewed.

CHALLENGE

Lao PDR is currently drafting rules and regulations for the carriage and handling of dangerous goods. It will be important to ensure that the rules and regulations consider the Upper Mekong Lancang Mekong Agreement and also the priority areas in Volume I- Risk Analysis identified for ports, ferry crossings and cargo vessels. The rules and regulations should be integrated with road and rail networks to improve the safety and efficiency of multi modal transport in the future.

Capacity building through training, seminars and/or workshops is needed in order to ensure that draft rules conform to existing international standards.

5.11 EXISTING RULES AND REGULATIONS FOR TRANSPORT OF DANGEROUS GOODS IN THAILAND

The possibility to enact or improve laws and regulations on transportation of dangerous goods in Thailand which focus on inland waterborne transport should be studied.

6. ENVIRONMENT

6.1 INTRODUCTION

The water resources of the Mekong River provide livelihoods for most of the 60 million people who live in the Lower Mekong Basin. These livelihoods to a large extent depend on the environmental health of the Mekong River and its tributaries remaining in good condition. Water quality is a key determinant of environmental health and is decreasing in the Mekong River Basin, impacting on agricultural land, important wetlands and biodiversity. Impacts to water quality are mainly due to increased urbanisation and socio-economic developments along the Mekong River.

The transport and storage of dangerous goods is a potential threat to water quality from oil spills and wastes generated by vessels, petroleum terminals and ports. The type and quantity of dangerous goods stored and transported on the Mekong River has been assessed to determine the risks of oil spills and pollution. Chapter 7 of the Risk Analysis (Volume 1) identified important wetlands in the Mekong Basin, reviewed the existing water quality monitoring (WQM) and water quality threats in the LMB.

6.2 PREPARATION OF RECOMMENDATIONS:

The Risk Analysis considered the potential environment impacts associated with the carriage, handling and storage of dangerous goods at ports, petroleum terminals, ferry crossings and onboard vessels. The following key outcomes of the Risk Analysis in relation to the environment were considered when preparing the recommendations:

- Oil spills in inland waters are highly likely to contaminate water supplies, affecting aquatic ecosystems and riparian populations;
- The main types of dangerous goods transported on the Mekong River are diesel, gasoline, kerosene and liquid petroleum gas (LPG);
- Fixed facilities and vessels are the major sources of spills for inland waters;
- Existing mechanisms to prevent control and monitor water pollution from navigation and other industries need to be enhanced in the Member Countries;

- Elevated levels of heavy metals have been detected downstream from navigation activities;
- Solid wastes are emerging threats to public health and water quality in the LMB;
- A number of ports and terminals built before EIA rules and regulations were implemented are not required to submit EMP to national line agencies to ensure compliance with standards for water quality, waste water and pollution prevention.
- There are no trans-boundary requirements for EIA;
- Monitoring of ports, terminals and vessel operations needs to be improved; and
- Cooperation between the national line agencies responsible for environmental protection and water resources and those responsible for inland waterborne transport and waterway safety needs to be enhanced.

The MRC has established a Water Quality Monitoring Network (WQMN) in the Member Countries with the purpose of providing timely data and information on the status and changes in water quality of the Mekong River Basin. The MRC has published a number of important water quality reports. The following references were used to prepare the Risk Analysis and these recommendations for the environment:

- *MRC Technical Paper No 15: Diagnostic Study of the Lower Mekong Basin;*
- *The Mekong River Report Card on Water Quality (2000-2006);*
- *MRC Technical Paper No 19: An Assessment of Water quality in the Lower Mekong Basin; and*
- *MRC State of the Basin Report, 2010.*

These references, outcomes from the risk analysis and studies from the Danube River and Rhine River were taken into account when preparing the recommendations.

6.3 RECOMMENDATIONS FOR ENVIRONMENTAL MANAGEMENT AND MONITORING

There are many challenges in the LMB, firstly to determine the impacts of increased navigation and secondly to ensure that adequate environmental protection measures are implemented at ports and terminals and onboard vessels to protect water quality and the vast fisheries and natural resources. The MRC Navigation Programme (NAP) will need to work closely with Member Countries, key stakeholders, the MRC Environment Programme (EP), other programmes and the private sector to ensure the recommendations for environmental management and monitoring can be implemented effectively.

6.3.1 Water Quality Monitoring

RECOMMENDATION
Enhance water quality monitoring to determine oil spill pollution and impacts of increased navigation and transport of dangerous goods.

CHALLENGE

The MRC Water Quality Monitoring Network (WQMN) has detected human impacts on water quality. Heavy metals and other industrial contaminants have been detected downstream of navigation activities. The source of the pollution cannot be confirmed. Currently the impacts of navigation on

water quality are difficult to determine under the WQMN and water-quality monitoring in Member Countries. There are no programmes in the Member Countries to investigate soil contamination, surface water quality and groundwater monitoring in the vicinity of ports, petroleum terminals and areas with high levels of IWT. Figure xx below represents the pollution hotspots in relation to the transport of dangerous goods, cargo and passenger transport in the LMB.

Figure 19: **Pollution Hotspots and Significant Navigation Activities in the LMB**

There is so single analytical method to characterise oil pollution due to its complex nature, or alterations in the environment. Fluorescence spectroscopy is an appropriate analytical technique for determining organic micropollutants having aromatic rings (s) in their molecules. Therefore, fluorescence properties of petroleum hydrocarbons can be used in oil pollution monitoring and research. Fluorescence fingerprints have been successfully used for characterising petroleum-related contamination in the Danube River[3]. Further investigation is required to determine an effective water quality monitoring in the Mekong River Basin.

6.3.2 Pollution Hotspots

RECOMMENDATION
Member Countries establish short-term water-quality programmes downstream from navigation activities and pollution hotspots.

CHALLENGE

To determine the impacts on increased water quality, further monitoring and analysis is required in pollution hotspots and areas with navigation activities and transport and storage of dangerous goods. The MRC WQM recommends that benchmark stations should be located at the six following sites:

1. Lao/China border (LS3) on the Mekong River;
2. Vientiane (LS5) on the Mekong River;
3. Prek Kdam (CP17) on the Tonle Sap;
4. Neak Luong (CS19) on the Mekong River;
5. Tan Chau (VP2) on the Mekong River; and
6. Chau Doc (VS21) on the Bassac River.

If short-term monitoring is undertaken to determine the impacts of navigation, the Member Countries requested that an additional seven stations should be included for pollution hotspot monitoring. These are Luang Prabang, the Lao/Cambodian border, Kratie, Tonle Sap (Tonle Sap Lake), Can Tho (Bassac), My Tho (Mekong) and Dong Thap (Mekong)

The Risk Analysis and national consultation meetings determined that further monitoring should also be undertaken on the Mekong and Bassac Rivers in Viet Nam to determine potential sources of threats to water quality in the Mekong Delta where IWT and the transport and storage of dangerous goods is most extensive.

6.3.3 Pollution Modelling

RECOMMENDATION
Future pollution modelling should determine the extent and possible trans-boundary impacts of water quality pollution including oil spills.

CHALLENGE

The potential for major oil spills is highest in Cambodia and Viet Nam due to the size of the petroleum terminals and tankers operating. Further analysis and hydrodynamic modelling is required to determine the possible trans-boundary impacts. The location of ports and terminals in relation to important wetlands, vulnerable areas, water intake (drinking) and public infrastructure also needs

careful consideration. Developing pollution modelling is difficult in the Mekong River and would require consideration on the type and quantity of oil, wind speed, flow conditions, high or low-water season, tidal influence and direction of flow in the Tonle Sap.

The type and quantity of oils carried by cross-border tanker barges and the location of petroleum terminals in Cambodia and Viet Nam is documented in Volume I and could be used for a pilot study. While these petroleum terminals and tanker barges have the highest potential to cause major oil spills, the extent of trans-boundary impacts has not been investigated. Knowing the extent of oil spill pollution allows early-warning systems, incident notification and emergency-response planning to be enhanced at the national and regional levels. Pollution modelling can be done in collaboration with the MRC Environment Programme under the implementation of Water Quality Emergency Procedures in Member Countries.

6.3.4 Sensitivity Mapping

RECOMMENDATION
Sensitivity mapping should be developed for the Mekong River to determine potential impacts of inland waterborne transport and other industries.

CHALLENGE

Further research is required to establish the location of petroleum terminals, ports and navigation in relation to sensitive areas, important wetlands, aquatic habitats and public infrastructure. Sensitivity mapping can be established with future pollution modelling to determine not only the extent of oil spill pollution but also the potential impacts to the environment and public health. Sensitivity mapping is mapping used to identifying sensitive sites, vulnerable areas, environmental and safety hazards and locations of ports, terminals, navigation hotspots and emergency-response facilities. Such mapping can assist the Member Countries to determine the severity of potential impacts of oil spills by identifying the location of important wetlands, water intakes (drinking), public infrastructure, tourism, fisheries and densely-populated areas. Sensitivity mapping can be used to support the preparation of water-quality emergency-response planning and management at both the national and regional levels in the event of trans-boundary pollution.

6.3.5 Environmental Impacts of Dredging and Sand Mining

RECOMMENDATION
Further studies could also evaluate the potential environmental impacts of dredging, sand mining and other navigation activities.

CHALLENGE

The scope of the Risk Analysis focused on the transport of dangerous goods and the potential operational impacts of petroleum terminals, ports, ferry crossings, cargo vessels and tanker barges. **During the national consultation meetings, the national line agencies were also concerned about the environmental impacts of dredging the navigation channel, sand exploitation and tourist and passenger services in the Mekong River Basin**. Future studies should be extended to focus on other navigation activities and also other industries along the Mekong River. It is important in relation to the whole Mekong Basin that there is a clear picture of not only navigation activities but of all different industrial sectors. This allows for more effective emergency response planning, monitoring and high-risk industries to be closely monitored for point-source pollution and impacts. The Danube River Basin has an inventory of potential Accident Risk Spots (ARS) to predict threats to the Danube River. A similar model could be applied to the Mekong River Basin.

6.3.6 Environmental Impact Assessment

RECOMMENDATION
The future development of ports and petroleum terminals in the Member Countries should include a dangerous goods risk assessment and consideration of trans-boundary impacts in EIAs.

CHALLENGE

There are two large ports under construction in the Member Countries are Chiang Saen Port II, Thailand, and Phnom Penh Container Terminal. The EIAs for these two ports were completed prior to the construction phase. However, the ports have not completed a dangerous goods risk assessment and it could not be determined if the potential trans-boundary impacts have been considered. It could also not be determined if the ports are required to prepare environmental management plans (EMP). These new ports present an opportunity to conduct a dangerous goods risk assessment and establish EMP prior to the ports commencing operations. These activities could include training for all employees to increase understanding and awareness of the risks associated with dangerous goods.

As an international river, with stretches where the international border follows the river alignment and stretches where the river crosses international borders, pollution in the Mekong will often become a trans-boundary issue. It is therefore essential that effective trans-boundary measures for preventing pollution and mitigating impacts of accidents, oil spills and pollution incidents are developed, agreed upon by the countries and enforced. The MRC has been assisting member countries to establish trans-boundary EIA for socio-economic developments along the Mekong River, this should include development of ports, terminals and navigation activities.

6.3.7 Environmental Management Plan

RECOMMENDATION
Member Countries should ensure the ports and petroleum terminals develop environmental management plans and are assessed by national line agencies.

CHALLENGE

A number of existing port and petroleum terminals have not developed environmental management plans (EMP). EMP can be used by national line agencies to evaluate how operators of ports and petroleum will manage pollution prevention, waste management, wastewater treatment and comply with environmental rules and regulations related to environmental protection and water quality. The national line agencies should also establish monitoring programmes to measure and monitor how the companies are performing against the EMP. The operation of petroleum companies and ports has the potential to cause major pollution and should be closely monitored.

6.3.8 Protected Areas and Important Wetlands

RECOMMENDATION
Control the transport of dangerous goods in protected areas and important wetlands in all Member Countries.

CHALLENGE

There were a number of important wetlands identified in the Mekong River, particularly in Cambodia where it was proposed in the Risk Analysis that transport of dangerous goods should be prohibited or restricted in two waterway sections:

1. Tonle Sap Lake, where domestic transport of petroleum products takes place from Phnom Penh to Chhong Kneas for floating fuel terminals; and
2. Steung Treng to Kratie where there is currently limited transport of dangerous goods with navigation characterized by local transport and tourist vessels. This section contains important wetlands and biodiversity on the Mekong River which should be protected.

Further assessment is required of the potential impacts of transport of dangerous goods and navigation in both these areas to ensure that adequate risk controls are in place to minimise impacts to water quality and biodiversity. The floating fuel terminals on the Tonle Sap Lake also require further investigation. The Tonle Sap Lake is the most productive inland fishery in the world and provides food security and livelihoods for millions of people in Cambodia.

6.3.9 Joint Statement on Protecting Environment and Promoting Navigation

RECOMMENDATION
Member Countries should prepare a joint statement committing on effective coordination for promoting navigation and protecting the waterway environment.

CHALLENGE

The Risk Analysis showed that more collaboration is required between the Ministries of Natural Resources and Environment, Water Resources, Public Works and Transport, other national lines agencies and the private sector. The Member Countries should commence the dialogue by preparing a joint statement that aims to achieve the important balance of socio-economic development in the navigation sectors with equitable and sustainable development on the Mekong River. Goals and measurable targets can be established to ensure that potential environmental impacts are well understood so impacts can be measured and mitigated.

In 2007, a *Joint Statement on Inland Navigation and Environmental Sustainability in the Danube River Basin* was concluded and very positively received by stakeholders. This initiative was launched in 2007 by the International Commission for the Protection of the Danube River (ICPDR) in cooperation with the Danube Navigation Commission and the International Sava Commission. The goal was to develop and commit to a *Joint Statement on Guiding Principles for the Development of Inland Navigation and Environmental Protection in the Danube River Basin*. This was achieved in late 2007. Inland navigation can contribute to making transport more environmentally sustainable, particularly where it substitutes for road transport. It can, however, also have significant influence on river ecosystems, jeopardising the goals of the EU Water Framework Directive, which aims for the "good ecological status" of all waters by 2015[4]. A similar framework can be developed in the Mekong River Basin.

6.3.10 Waste Management

RECOMMENDATION
Member Countries should ensure that waste-disposal facilities are established for solid and liquid wastes along the Mekong River.

CHALLENGE

The operations of ports, terminals and vessels have the potential to generate both domestic and hazardous wastes. Currently, industrial and municipal waste management plans in the Member Countries are limited, increasing the risks to both the environment and public health. It was observed

that some oily wastes are disposed of directly into the Mekong River. The potential impacts are high as heavy oils are persistent and can impact on surface water quality, fish and aquatic organisms. The technical requirements for waste reception facilities are covered in further detail in Chapter 2 (Ports and Terminals) and Chapter 3 (Vessels). Establishing solid-waste management plans will also be an important requirement for port, terminal and vessel operators. Member countries will need to ensure that adequate waste-reception facilities are developed.

6.3.11 Public Information and Awareness

RECOMMENDATION
Public information and awareness programmes should be developed for dangerous goods, oil spills, waste management and environmental protection.

CHALLENGE

Lack of awareness contributes significantly to the increased risks of fire, explosion, injury, loss of life and pollution. Awareness and level of understanding was determined as very high priority area in all of the Member Countries for ports, terminals, vessels and all waterways users. Public information campaigns should be delivered to key stakeholders including port authorities, shipping operators, petroleum companies and waterway users to improve understanding and awareness of dangerous goods, environmental protection and correct disposal of solid and liquid wastes. Creating increased awareness of environmental issues associated with navigation with decision-makers and key stakeholders is important to balance the socio-economic developments in the navigation sector with environmental protection.

7. THE NEXT STEPS

7.1 FROM RECOMMENDATIONS TO IMPLEMENTATION

The objective of Phase 1 was to identify and determine the magnitude of risks associated with the storage, carriage and handling of dangerous goods along the Mekong River and determine the prevention and mitigation measures to manage the risks. Volume I (Risk Analysis) detailed the baseline situation and the priority areas for improvement of the transport of dangerous goods in each of the Member Countries and at the regional level. Volume II provides recommendations related to ports and terminals, vessels, waterways, the legal framework and the environment.

The recommendations for ports and terminals can be applied to management and operations as well as national line agencies responsible for compliance and enforcement activities. The recommendations provide guidance on technical, management, training and institutional capacity to improve the priority areas determined in Volume 1. Both prevention and mitigation measures are proposed to ensure the safe operation of ports and terminals. The recommendations focus on developing safety, health and environment management systems, capacity building, maintenance and operation of critical equipment, technical standards, design requirements and emergency firefighting and oil-spill response.

The recommendations for vessels focus on construction and design, developing minimum safety requirements for equipment onboard, managing dangerous goods, training and certification and emergency, oil-spill, lifesaving and firefighting responses. The recommendations also consider developing safety rules and regulations for domestic, cross-border and international vessels transporting dangerous goods. National line agencies will be required to enhance monitoring and compliance activities. The recommendations can be applied to general cargo vessels carrying packaged dangerous goods and also tanker barges transporting dangerous goods in bulk.

For waterways, the recommendations call for developing minimum safety standards for navigation, communication equipment and waterway for vessels transporting dangerous goods. The Member Countries will need to further enhance waterway safety infrastructure including automatic identification systems (AIS), GPS, aids to navigation systems, electronic navigation charts. Emergency response

mechanisms need to be established in the Member Countries to respond to oil spills and accidents along the waterway.

The recommendations for the legal framework call for a need for harmonising rules and regulations for the transport of dangerous goods along the Mekong River. It will be important to determine whether a single safety agreement can be harmonised for all four MRC Member Countries or whether two separate agreements are needed for the the Lower Mekong (Cambodia and Viet Nam) and the Upper Mekong (Lao PDR and Thailand, possibly including the People's Republic of China and Myanmar as well). When developing agreements, rules and regulations, the MRC Member Countries will need to consider the existing national rules and regulations, international standards (such as the IMDG Code) and regional agreements.

The recommendations for the environment call for enhancing water-quality monitoring to determine the impacts of navigation and the extent of oil spill pollution. Further early warning and incident-notification systems need to be established for water quality emergencies and more assessments are required to determine trans-boundary areas. Further coordination is required between transport, environment and water-resource line agencies to ensure sustainable development. Public information and awareness needs to be improved for environmental protection for key stakeholders, national line agencies and private sector.

During the Final Regional Workshop in Bangkok on 12 and 13 January, 2012, five working groups were established for ports and terminals, vessels, waterways, the legal framework and the environment. The first objective of the working groups was to determine both the national and regional priorities for the recommendations contained in this volume. Priorities could be rated very high (4), high (3), medium (2) and low (1). The MRC Navigation Programme and the international consultants helped the working groups prioritise the recommendations and results were recorded in national and regional priority worksheets for ports/terminals, vessels, waterways, the legal framework and the environment.

The second objective of the working group sessions required the participants to provide inputs on how the recommendations could be implemented by the Member Countries. The recommendations were all found to be very high (4) and high (3) by the working groups. These results are integrated into this final report and will need to be reviewed further by national line agencies, the private sector and other key stakeholders during the establishment of the *Implementation Strategy for the Sustainable Management of Dangerous Goods* project. This marks Phase 2 of the sustainable transport of dangerous goods initiative under the Traffic Safety and Environmental Sustainability component of the MRC Navigation Programme. .

Some recommendations proposed are specific to the five main components of the risk analysis project; ports/terminals, vessels, waterway, legal framework. Some important synergies were identified:

1. **Enhancing the existing legal framework, developing agreements, national rules and regulations, harmonising standards on a regional basis and institutional strengthening;**
2. **Improving enforcement and compliance of vessels, port and terminal operations in relation to waterway safety, environmental management, pollution prevention and waste management;**
3. **Developing public information and awareness campaigns for all waterway users; and**
4. **Establishing mechanisms for improving emergency response including oil spill response, waste management and monitoring of navigation activities.**

These are cross-cutting recommendations that can be implemented on a regional basis. For example developing a public information and awareness campaign can be targeted to all waterway users including port authorities, port and terminal operators, shipping companies, the fisheries and tourism

sectors, riparian communities and national line agencies to improve the management of dangerous goods, prevent pollution and manage solid and liquid wastes. Some of the recommendations proposed could require implementation only at the national level by the Member Countries with assistance from the MRC.

Some of the recommendations are only specific to the five components of the risk analysis, particularly ports/terminals and vessels. A number of prevention and mitigation measures were recommended for the operators of ports, terminals and vessels. These recommendations can be implemented by private companies or authorities responsible for management of ports and vessels. The MRC and the Member Countries must also consider how the national line agencies responsible for the overall management of ports and inland navigation can ensure the institutional capacity and technical standards or guidelines can be enhanced to ensure effective monitoring and compliance. These recommendations in Volume II will be integrated into the implementation strategy project in Phase 2.

7.2 IMPLEMENTATION STRATEGY FOR THE SUSTAINABLE MANAGEMENT OF DANGEROUS GOODS

The *Implementation Strategy for the Sustainable Management of Dangerous Goods* project will require the development of a detailed strategy and implementation plan for the Member Countries to manage and control the risks associated with the transport of dangerous goods in the LMB. The overall objective of the Navigation Programme is *"to increase the efficiency of domestic and cross-border waterborne transport in the Lower Mekong Basin, by reducing the risks for accidents in ports, on the vessels and on the waterways so that the ecological health of the river, which is the basis for food security and livelihoods, is not compromised by shipping activities, operations and developments."*

The implementation strategy will contribute to reducing the risks for accidents in ports, on vessels and waterways and for prevention management of oils spills and pollution from navigation activities. Phase 2 will require the development of a detailed prevention and implementation measures to manage and control the risks identified with the transport of dangerous goods (Phase 1). Figure 20 below illustrates how the outputs from Phase 1 will be used to move towards implementation.

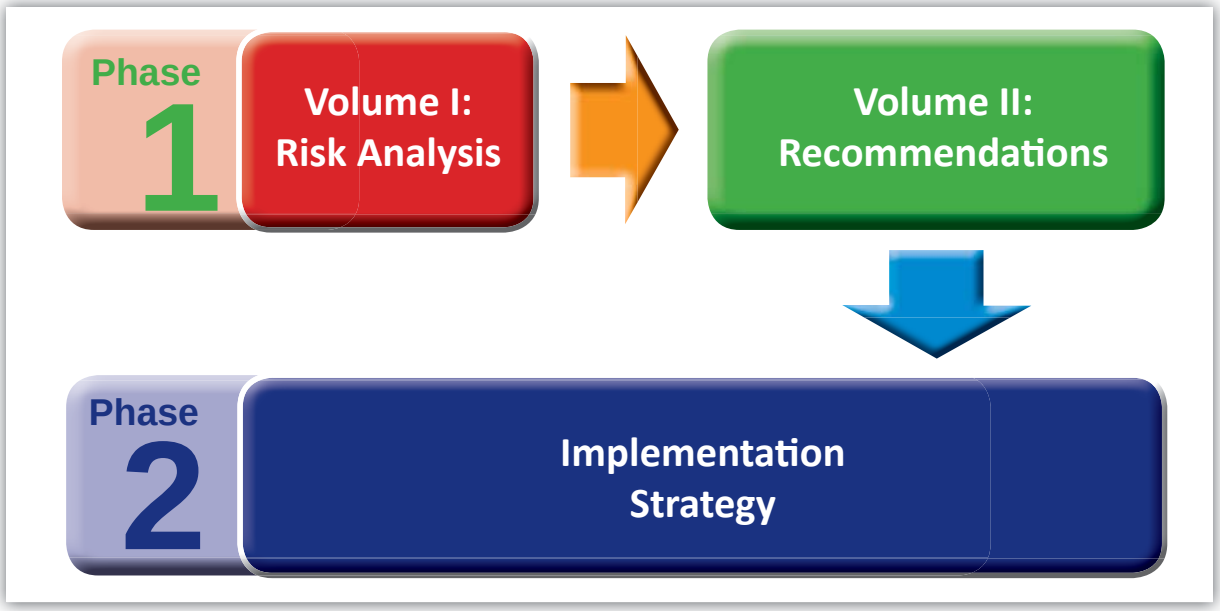

Figure 20: The Risk Analysis and Recommendations are part of Phase 1 of the sustainable transport of dangerous goods initiative of the Traffic Safety and Environmental Sustainability component of the MRC Navigation Programme. Phase 1 dates back to initial consultations with Member Countries in 2009. Phase 2, is scheduled to start in 2012.

The implementation strategy will need to determine to what extent international, national and/or local action plans are needed and to take in to consideration the current institutional capacity and levels of socio-economic development in the Lower Mekong Basin. An implementation strategy and action plans will be developed, detailing the short, medium and long term actions, costs and resources required for implementation by the Member Countries and implementation agencies including MRC. The implementation strategy will be required to prepare for capacity building programmes for improving institutional capacity in the MRC Member Countries, and the capability of each country to be able to adopt rules and regulations for emergency response and the prevention and mitigation of risks and impacts. The action plans will need to determine how the recommendations are to be implemented by the Member Countries and include the information detailed below in Table 7.

Table 7: **Sample Action Plan Required for Phase 2**

Action Plan	
Background and Rationale	As identified from the Risk Analysis (Volume 1) and Recommendations (Volume II)
Objectives:	
Outputs and Deliverables:	
Project Area	
Activities	
Budget, Costs and Resources Required	
Implementation Agency	
National/Regional (MRC) Implementation	
Stakeholder Analysis	
Socio-Economic Issues	
Risks	
Priority of Action: Very High (4), High (3), Medium (2) and Low (1)	As identified by the Final Regional Workshop and National Consultation Meetings in Bangkok in January, 2012.
Work Plan and Schedule	

Action plans will be prepared for the five key components of the risk analysis project (ports/terminals, vessels, waterway, the legal framework and the environment). The action plans will need to evaluate whether the implementation is undertaken by MRC at the regional level or requires implementation at the national level by the relevant line agencies, development partners and the private sector including development banks. Some actions plans may also include the implementation of infrastructure projects, particularly in relation to emergency-response mechanisms, monitoring and improvements in waterway safety.

Phase 2 will be an important step to take the recommendations from Volume II based on the risks evaluated in Volume I and develop feasible and practical action plans and project portfolios that can be implemented effectively by Member Countries with assistance from the MRC and other implementing agencies such as development banks. As an initial concrete step, Thailand asked the MRC Navigation Programme in January 2012 to implement a pilot project for the sustainable management of dangerous goods at Chiang Saen Port II. Through the Navigation Advisory Board, comprising senior officials of the transport ministries, Member Countries accepted the proposal and asked the MRC to start the project by April. The management plan developed for dangerous goods at Chiang Saen II could be applied to other inland ports in the Mekong Basin. The second phase will be prepared in May 2012 and implemented from 2013 with the overall goal of increasing the safety and efficiency of navigation while preventing environmental damage from waterway infrastructure or shipping and port activities.

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